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ACCURACY OF STEELWORK

for Highway Structures

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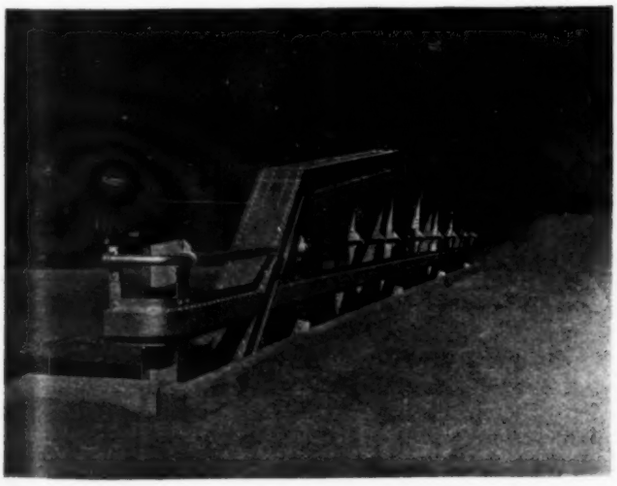
HIGHWAY engineers, supervising projects which include structural steel, rightly view with suspicion the erectors' use of shims or of an oxy-acetylene cutting torch to make the steelwork fit together. They know that, justly or not, the presence on their job of steel parts excessively shimmed or hastily flame-cut will reflect adversely on their own ability. But since replacement of badly fitting parts with new would cause serious delay, engineers frequently allow misfits to be patched up in spite of their desire to deliver a faultless job.

Reputable structural steel fabricators and erectors, no less than highway engineers, deplore badly fitting steel work. Not only do misfits imperil completion dates, but they also cause expense for correction and for idle time of erectors. Worst of all, the bad workmanship displayed by misfits is a perpetually injurious advertisement for the fabricator. Because the likelihood of misfits is greatly increased by the speed demanded today in fabrication and erection, steel men are studying as never before the problems of accuracy.

Their study has brought out the fact that, in addition to the ordinary correct drafting and shop procedure, the factor of "tolerance" must be carefully considered. Tolerance in steel work is the amount of its variation from nominal or stipulated dimensions, angles, and centerlines and from perfect straightness longitudinally. Variation from absolute accuracy is, of course, inevitable. The problem is, first, to determine reasonable tolerance and then to provide unerringly for them. The old time fabricator disposed of the matter offhand by saying, "Give 'er a half inch clearance," and produced steel work that offended everyone who expected it to be as workmanlike as the carpentry or masonry that it displaced.



For Fast Erection of Steel Work in Remote Localities, the Accurate Fit of Parts Is Essential

Close Tolerances on Steel Work Are Fruitless Unless Parts Are Carefully Handled and Shipped

Tolerance in Material.—The tremendous rate at which steel must be rolled to make it a competitive construction material precludes the microscopic tolerances of the machine shop. However, considered from a percentage standpoint, dimensions of rolled steel are quite as close to perfection as are its remarkable uniformity of strength and chemical composition. Slight as its variations are, yet they do have a distinct influence on the proper fit of the units of which they are a part.

Variation from nominal dimensions in cross-section of steel shapes is due to two conditions of their manufacture: first, the method of increasing cross-sectional area by spreading the rolls and, second, the wear and improper adjustment of the rolls.

The blackened areas in Fig. 1 show the minimum cross-sections of I-beams, channels, angles, and wide flange beams. The hatched areas are those added by spreading the rolls. In general, nominal dimensions apply closest to minimum sections. Errors in allowing for this added section with I-beams, channels, and wide flange beams are not frequent because the tables of steel handbooks customarily dimension them exactly. With angles, however, the tables list only nominal dimensions, so failure to allow for the added material is common. Overrun of angles varies from 1/16 to ½ in. on each leg, depending on the standards of the mill rolling them. Inciden-

tally, the angle between the backs of an angle *may* vary from a right angle by about one degree (¼ in. in 12 in.).

Because the variations due to wear and improper adjustment of rolls are irregular, fabricators will do well to insist that material, at least for important jobs, be actually measured on the receiving skids and the results tabulated for the drafting room. Fortunately, the former practice of certain mills in disposing of "off size" material at reduced prices has virtually disappeared.

The following list indicates maximum variations from the dimensions of beams published in the handbooks:

(a) Depth at the center may be plus ⅛ in. to minus ⅛ in.

(b) Width of flanges may be plus ¼ in. to minus 3/16 in.

(c) Flanges may be out of square with the web by ¼ in. in the width of the flange. This variation may occur in one flange or be divided between the two. The maximum depth over the tips of the flanges must not exceed the tabular depth by more than ¼ in.

(d) The web may be off center of the flange by 3/16 in.

The common tolerance for camber and sweep in the length of a beam is 1 in 1000 with a maximum of ½ in. This variation is measured between the actual centerline of the beam at any point and the theoretical axis joining the centers of the two ends.

The amount of twist acceptable to a fabricator should be governed somewhat by the manner in which the beam will be framed. If the beam is to be attached by the flanges, then a twist of one degree (nearly ¼ in. in 12 in.) for 20 ft. of length is allowable. Half of this should be a maximum for a member framed with wing angles.

For plate thickness the minus tolerance is 1/100 in. and the plus 2% for thick, narrow plates up to 19% for thin, wide ones. Edges of a plate are almost always thinner than the center. The camber of universal mill plates is restricted to ¼ in. in 10 ft., while that of sheared plates should be virtually zero. Actual measurement and tabulation of plate dimensions, as with beams, is desirable for important work.

In justice to modern rolling mills, it should be said that the accuracy of their products customarily falls far within the tolerance listed.

Shop Methods for Reducing Mill Variations.—The fabricating shop cannot readily reduce excessive variations in cross-sectional dimensions. However, it can reduce camber and sweep by straightening processes. For example, camber in universal mill plates up to 24 in. in width may be removed by rolling the concave edge. Camber and sweep in long beams is eliminated by weighting the middle of the beams and then pulling upward on the ends with a crane hook. Bends in short beams are readily removed by a bulldozer.

Tolerances in Fabrication and Erection.—Customary fabricating and erection tolerances are as follows:

(1) Dimensions of members, which frame to other steel parts and which are not milled, are kept within 1/16 in. up to 30 ft. and ⅛ in. over 30 ft.

(2) Dimensions out to out of milled ends are kept within 1/32 in.

(3) Center to center of bored holes is within 1/32 in. of the true dimension. A few shops can bore large holes simultaneously with a center accuracy of 1/100 in. Maximum distances between such holes is 96 ft.

(4) The actual axis of a member shall not depart laterally from the theoretical axis joining the centers of the two ends by more than 1/1000 of the length of the member.

(5) Other dimensions specially noted on the drawing can be kept to the nearest 1/32 in.

(6) Accuracy of angular dimensions is usually measured, not in degrees, minutes, and seconds, but by plus or minus 1/16 in. in the base and altitude of the triangle determining the angle. For small parts, such as wing angles, where a steel square is used, an accuracy of about 15 minutes (1/16 in. in 12 in.) is usual.

(7) The angle of a milled surface with its axis should be within 5 minutes of arc (about 1/64 in. in 12 in.) of the specified angle. Ordinarily, no specification for smoothness of finish is given. Incidentally, milled surfaces which slide upon one another should be planed in the direction in which they are to slide.

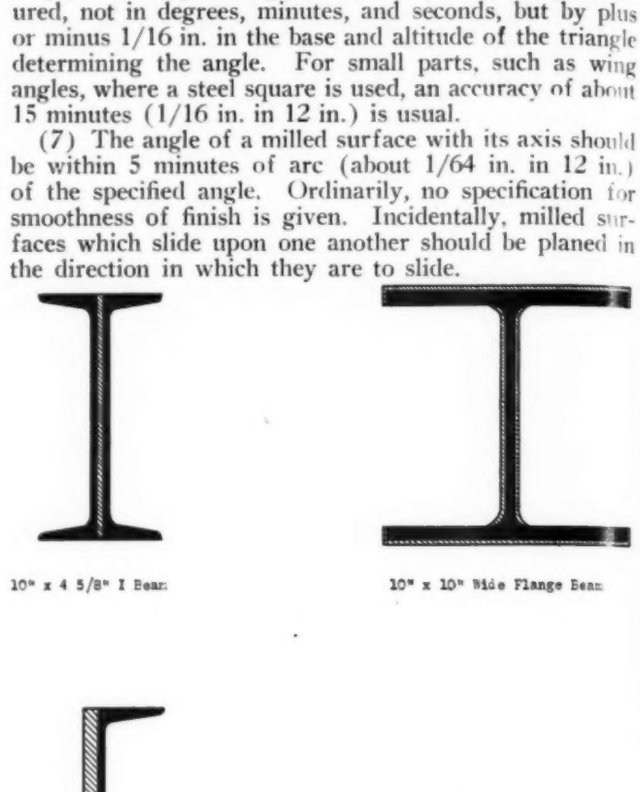


Fig. 1

(8) Steel frames shall be considered plumb and level when the error does not exceed 1 in 500. In special cases, accuracies of 1 in 1000 or even of 1 in 2500 will be delivered without extra charge.

It will be noticed that tolerances for length are generally a fixed figure independent of the length. This condition arises from the use of steel tapes as the standard of measurement. Since these tapes are generally accurate to less than 1/16 in. in 100 ft. under an average pull, steel fabricators assume them to be exact. Temperature corrections are unnecessary because the tape and the material have similar temperatures. Variations in length occur; first, in transferring the measurement from the tape graduation to the steel and, second, in registering the marks on the steel under the shear, punch, or milling machine. Obviously, such variations are independent of the length.

Methods for Reducing Fabricating and Erection Tolerances.—As stated previously, fabricators cannot reduce appreciably the tolerances in their raw materials. However, by skilfully playing plus and minus tolerances against one another, they can obtain high accuracy in the combination of their materials. Again, by working to essential dimensions and allowing all others to come where they will, extreme exactness becomes a routine matter. For example, the careful shopman will lay out holes in a beam flange from the center of the web rather than from the center of the flange, since he knows that otherwise the 3/16 in. tolerance between these centers may cause a misfit.

Since the various fabricating processes—shearing, punching, bending, flame-cutting, and welding—cause distortion of the steel, allowance must be made for it. For example, an angle for a plate girder flange stretches at the rate of 1/16 in. per 10 ft. on punching. On the other hand, punching does not elongate a wide web plate for such a girder. Thus, if the girder is 100 ft. long, the holes in the angles will outrun those in the web 5/8 in. and thus require excessive reaming, unless compensated for in laying out.

Since a narrow plate punched only along one edge will always buckle or camber, good practice would arrange two lines of holes equi-distant from the edges. Channels and I-beams are also warped by punching and must be straightened before further assembly.

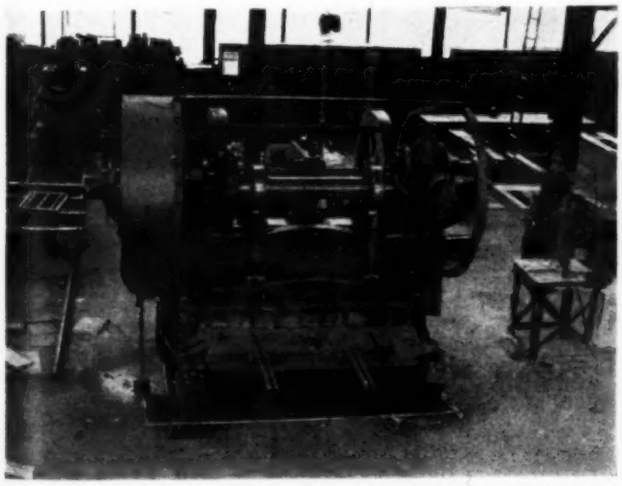
Angles punched in either or both legs not only stretch but also warp badly. Some fabricators trust that the parts to which such angles are assembled will pull them into line. However, for the best work, angles should always be straightened before assembling.

Because of the unavoidable distortion caused by punching, all parts that must be extremely accurate—for example, steel work directly connected with machinery for moveable bridges—should be drilled from the solid.

All high grade structural shops "spear out" the rivet holes in assembled work with a five-fluted reamer so that riveting will not drift the work out of shape. In addition, they avoid, by using rivets of the proper length, the distortion caused by the heavy pressure of riveting machines on the parts fastened together.

Specifications frequently call for holes punched 3/16 in. smaller diameter than the rivet and then reamed after assembly to 1/16 in. larger than the rivet, under the mistaken idea that the metal around the holes has been made brittle as glass by cold working and should be removed. Actually, the metal has been made stronger by the punching. The important thing, so far as accuracy and strength of the structure is concerned, is that holes be cylindrical, not slotted. For this purpose subpunching to minus 1/16 in. and reaming to plus 1/16 in. is entirely adequate and much cheaper. Other important considerations for accurate work are that punching burrs be removed and that contact painting be omitted.

For absolute accuracy in matching of field connections

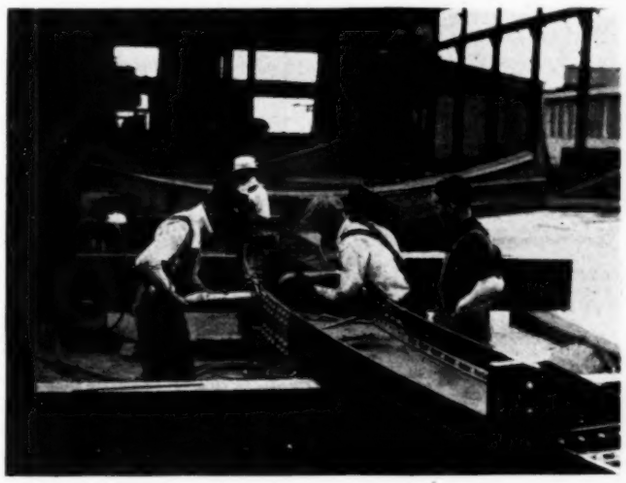


This Gate Shear Will Work to 1/32 in. if the Work Is Properly Marked and Registered

the fabricator offers two methods: first, reaming of field holes while parts are temporarily assembled in the shop and, second, drilling or reaming to steel templets. Steel templets are made of 3/8 in. plate having holes fitted with hard steel bushings about an inch long. There is a growing conviction on the part of steel men that shop assembly usually justifies its cost by the rapidity and certainty with which field erection proceeds.

So far as welded work is concerned, the measure of a good structural welder is not that he produce sound welds, for such are expected, but that he produce assemblies free from distortion. Clamping the work, preheating, annealing, and welding sequence are all elements influencing the accuracy of welded work.

Finally, the generous use of temporary adjustable tie



Close Standards of Accuracy Are Particularly Necessary for Curved Members

rods for erection should be encouraged so that the plastic bolted assembly will be snugly held until it is made rigid by riveting.

How the Highway Engineer Can Aid the Steel Man.—The highway engineer can help the cause of accuracy in two ways; first, by supplying the steel man early in the job with an accurate survey to the nearest 1/16 in. of all pier centers and anchor bolts and, second, by constructing his piers to the proper elevation and finish.

The steel man is not nearly so anxious to have the tower and girder spans in even feet as he is to have exact measurements. He can secure any necessary duplication or adjustment by slotting anchor bolt holes or by using riveted fillers. If steel erectors must sledge over anchor bolts and perhaps crack the concrete in doing so, they are apt to say to themselves, "This sure is a sloppy job anyhow, they won't be particular about their steel work."

We have agreed before that the use of shims is a reflection on the ability of the fabricator. The use of grout under a column, shoe, or pedestal is no less a reflection on the pier builder. With skilled instrument men, form builders, and concrete finishers readily available, there is no valid reason why piers should not be set to the nearest 1/16 in. or even 1/32 in.

It has been greatly to the self-interest of the automobile manufacturer to reduce his tolerances to limits undreamed of ten years ago. It is my opinion that the self-interest of engineers and fabricators will be likewise served if they, too, strive for better fitting work so that it is above adverse criticism.

▼

40 Miles Per Hour or More Through Hearts of Cities.—Traffic speeds of 40 miles an hour or more through congested business districts are prophesied in a report submitted to the city of Chicago by Dr. Miller McClintock, director of The Albert Russel Erskine Traffic Bureau at Harvard University.

The increase in speed will be made possible by means of elevated highways with acceleration and deceleration lanes, urged upon Chicago by the report.

Device for Forcing Displaced Slabs Into Position

THE earthquake of March 10, 1933, caused much pavement distortion and displacement over tidal flats on Route 60 in Orange County, California. A mudjacking outfit was promptly sent from Sacramento but even after this crew had restored slabs to grade there still remained wide gaps between adjacent slabs extending for lengths of several hundred feet over a distance of 10 miles in the vicinity of Huntington Beach, Calif. There were 15 such areas ranging from 140 ft. to 400 ft. in length, and in width from 2¼ in. to 8½ in. At first these were considered for filling with asphaltic concrete or later with portland cement concrete. Temporary repairs were made with the first mentioned material. T. H. Dennis, State Maintenance Engineer, thought an effort should be made to pull the adjacent slabs together so plans to that end were set on foot. How this work was handled is told by I. S. Voorhees, District Maintenance Engineer, California Highway Department, in September Highways and Public Works.

Since the force that had created the displacement was tremendous, it was self evident that in some way great force must be marshaled for correction. This problem was not so easy but was finally worked out with the aid of Superintendent W. B. Cannon of the District Equipment Department.

It was obvious from the first that the force to be invoked must bear some relation to the weight of the slab to be moved with proper allowance for friction. The slabs weighed about 50 tons, so steps were taken to develop a force at least that much. The job being experimental without precedents to guide it was aimed to keep costs down so that if the machine did not work there would not be much loss.

The assembly consists essentially of a rectangle designed for working under the theory of parallel forces. The upper member of the force rectangle was made up of 8⅝ O.D. 42-lb. well casing, which also served to support the mechanism on the trailer.

The lower member consisted of two pieces of ⅝ x 8 in. Universal plate approximately 40 ft. long, separated at the ends with steel blocks 12 in. square and 1½ in. thick welded in there. The ends of the rectangle were made up of 8x 8 in. steel billets approximately 50 in. long. Rotating pivots for the movable ends were made of 2-in. nickel steel shafting welded to plates clamped to the billets.

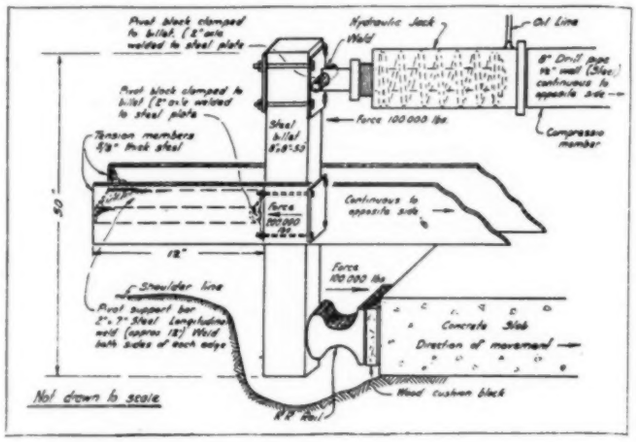
The 1½ in. plate in one end of the lower or tension member was bored to fit the shaft as was also the end of the jack. The bottom pivot fitted over the head of a piece of 80-lb. rail 24 in. long which was placed against the concrete with packing pieces of Oregon pine in order to distribute the load and not fracture the edges of the slabs.

Such filler pieces of wood were particularly essential at the start when the gaps between working ends were approximately 30 ft. and were used on both the stationary and movable ends.

As it was uncertain just how far the pavement could be moved at one time without damage, it was planned to give a 4-in. stroke at the pavement and an 8-in. one at the jack, thus securing a 2:1 leverage which aided in the power build-up. As events showed, this proved about right as it permitted movement of the pavement of about 1 in. at each operation, even after making due allowance for crushing of the lumber.

The jacking device was built out of a piece of 6⅝-in. casing, oil being circulated by a small triplex pump driven by an air cooled engine. A bipass valve was built into the pump, so that by closing the valve, pushing immediately started as the engine ran continuously, and releasing such valve caused the lever to retract. The jack plunger moved at the rate of slightly over an inch per minute so that each push took about five minutes. Moving and setting up consumed a similar period.

A pressure gage was used in order to keep track of performance. It was found that pressure would at times go up to 3,000 lb. per square inch without distress. The



Isometric Sketch of the Movable End of Pavement Jacking Assembly Showing Details of Construction and Connection

only trouble experienced was from grit in the oil getting into the bipass valve. Average pressure was 1,500 lb.

At first an effort was made to operate with a hand outfit, but this proved too slow and laborious, so the triplex pump and aircooled engine were installed.

Pressures ranging from 30 to 50 tons were utilized after the slabs had started moving and 75 to 90-ton pressures were required to start such movement.

As the outfit must necessarily be portable, even while working, it was built crosswise on a 2½-ton trailer with compression member above and tension member below the trailer frame. A gallows frame to support chain blocks was built to raise and lower it.

The cracks between adjacent slabs were thoroughly cleared of all materials to a depth of 2 in. below the concrete, and at each joint in the pavement the shoulder was excavated to subgrade for a length of 3 ft. and width of 18 in. After such preliminary work the machine was lowered until the lower end of the steel billets was on a level with the bottom of the concrete slabs.

The building and operation of the machine covered a period of about four weeks. Pavement alignment was restored at 11 locations where the cracks totaled 3,370 ft. in length with an average width of 4.47 in. presenting a total area of 139.55 sq. yd. There was an average of 6.89 sq. yd. of gap closed per day at an average cost of $6.21 per yard.

The work was done at a net operating cost of $866.09 of which $709.90 was for labor and $156.19 for rental.

LAWS PERMIT HIGHER SPEEDS.—Twenty-two states now have "reasonable and proper" as the only top speed driving restrictions, according to Dr. Miller McClintock of the Albert Russel Erskine Traffic Bureau of Harvard University. One state has a 50-mile per hour limit and thirteen say 45 miles per hour is okay. In fact, the general average of those states which have definite restrictions is 38 miles per hour.

The Highway Recovery Program

By Thomas H. MacDonald
Chief U. S. Bureau of Public Roads, Washington, D. C.

WHEN the nation united to use its great strength to overcome depression and to restore a normal national life, it was necessary to plan attacks upon many major objectives. To achieve effective results, agencies capable of functioning on a country-wide scale were essential. It was inevitable that the State and Federal highway organizations should be called upon to take a prominent position in the front line of the offensive operations since, together they constituted the only national agency actually organized to execute public works on a scale adequate to sustain existing and to provide increased employment, through properly planned and competently executed construction projects. Even so, it was not so clearly evident as it is now that the highway organizations must become the shock troops to point the entering thrust of the "war against unemployment" army which the Public Works Administration has been rapidly marshalling into form and simultaneously driving into action. The disappointment recently expressed by the Public Works Administration that a larger number of projects is not now actually under construction, springs from no lack of appreciation of what has been accomplished but from the absolute necessity of a further acceleration in the rate of expenditure and of increase in employment.

The existing unemployment must be relieved to the fullest extent of the possibilities within the highway field. The responsibility that is imposed upon the State and Federal Highway Departments is one to test to the utmost their individual and organization competency. Against this, the high merit of the cause provides both an inspiration and an opportunity to put country before precedent and revitalize the public's appreciation of their highway administrative organizations.

Six months ago a careful survey of future employment in the Federal and State highway field indicated that the normal and emergency highway employment would reach its peak in June and, unless an additional construction program were undertaken, would rapidly diminsh and about the first of September would fall precipitately. Actual State and Federal employment in June reached practically 360,000; in August it dropped to 330,000; and the preliminary estimate for September is 325,000.

During September the new program was just beginning to make headway. Our job now is not only to counteract the seasonal decline of highway employment but actually to increase the number employed, when weather conditions and past experience would indicate this to be the impossible. The drag of 30 days used to organize the whole program will be made up, and more, within the next 60 days.

Status of Highway Program—Here is the immediate status as of Oct. 7:

Projects estimated to cost $95,000,000 are under contract.

Additional projects estimated to cost $45,000,000 are approved and ready for contract.

Work is actually under way in 44 States and the District of Columbia.

The rate of preparation, submission and approval of completed plans for new projects has now reached 1,100 per month. This means that upwards of 4,000 projects will be prepared and approved and a large percentage of them under actual construction by December 1. The number directly employed on highway projects is a wholly inadequate index of the amount of employment provided or of the number who share in the funds expended for such work.

While the actual relation of the direct job employment to the expenditure varies between wide limits by reason of the difference in the types of construction, it is well established that 80 to 85 per cent of the total disbursements goes for labor and employment. At least 75 per cent is distributed quickly to sustain employment.

This bare statement of the relationship between construction expenditure and employment creates no adequate impression of the disastrous unemployment consequences that have attended the breakdown of the construction industry. The most optimistic estimates would probably not place our total construction for this year above $2,000,000,000 to $3,000,000,000. This is less than one-third of the goal upon which the nation must fix its determination, including both private and public construction, before we can reestablish adequate earnings not only for those who participate directly and through industrial production, but for the growers and producers of food, manufacturers of clothing, retailers of goods, and for those not engaged in commerce but in all the professions.

In an informal memorandum addressed to the State Highway Departments in June, I stressed the point that the primary purpose behind the whole industrial program is employment relief on a widely distributed basis. The intervening weeks have accented this aspect.

Changes to Expediate Work—That we might have an expedited though orderly plan of the work, every possible provision has been made by the Bureau, with the approval of the Secretary of Agriculture and the Federal Administrator of Public Works, to reduce the time required for each step to the minimum. Changes have been made in previous procedure, of which the most important are:

To the States which did not have adequate working capital and to those whose State laws did not provide for the use of State funds in municipalities or on secondary roads, the advance of working or revolving funds.

The reduction of time for advertising.

The preparation of agreements in the field.

The provision for abbreviated plans for secondary roads.

The authorization to proceed with direct labor con-

struction of secondary roads without prior preparation of plans.

The provision for the immediate payment of bills through the revolving fund.

These and other time saving changes in method have been adopted in the belief that the States would operate in full cooperation with the Bureau to provide sound administration and adequate engineering. Several States do not yet have a sufficient number of competent engineers to carry the work into execution rapidly. Where these conditions exist, the approval of the Special Board for Public Works to begin operations has been contingent upon satisfactory engineering performance. Since, if necessary, the States have authority to employ engineering assistance as a part of the cost of the projects to be paid from the Federal funds, there certainly can be no excuse for either an incompetent or an inadequate force of engineers to handle the work properly.

An adequate engineering organization in each State is perhaps the one most important consideration. The failure to provide such an organization is more likely to result in friction between the State Highway Department and the Bureau or in slow progress of the work than any other cause.

Employment Principal Objective—From the beginning of the Federal highway work, policies have been directed toward the building of a national system of highways as the principal objective. Now, employment is the principal objective and the most important reason for making available to the highway departments an appropriation more than three times as large as the annual Federal contribution for highways heretofore. It is difficult to impress this point upon those whose wholehearted efforts and ambitions have been wrapped up in the effort to bring to completion the major highway systems as such.

The employment needs are, in the main, proportional to population. Thus, to relieve these needs, the highway departments are projected into fields which they have not heretofore occupied and for which they were to a considerable extent unprepared.

The undertaking of work both in the cities and on the secondary or feeder roads is a logical development and in keeping with the direction in which the public mind has been moving for some time. This legislation provides a means for correcting many objectionable conditions of long standing on the main routes within the cities, and at the same time bringing employment to the worker rather than attempting to move the worker to some remote job.

Likewise, secondary road construction will prove a godsend by furnishing employment to carry many agricultural communities through this period of distress, while providing road facilities for which there has been a constantly increasing demand.

States Enter New Fields of Highway Improvement—Both of these fields are important from the standpoint of public service which may be rendered by the highway departments. The entrance of the States and the Federal Government into these new fields of highway improvement accents the necessity for State-wide planning of highway facilities. Accurate surveys have definitely indicated the high percentage of the total traffic which is of municipal origin. This traffic has been a very large contributor to the annual income of the States devoted to highway purposes and it is now only just that the major routes within the cities shall be brought to adequate standards for the traffic.

The proper planning and limitation of the feeder road system are of vital concern. It is important that a proper relation be maintained between these roads and the major road system and that an annual income available for their further improvement and maintenance shall be assured. Planning, to be worthy of the name, must provide for mutiple traffic lanes along many of the major routes, for wider rights of way and for projecting arterial routes into and through the hearts of the business districts of municipalities. This is the only way to maintain present property values and to prevent what may be termed the migration of wealth.

It is equally important that the improvement standards now in effect for major State highways be revised to meet the relatively lower requirements of secondary roads. Lighter surfaces are justifiable but all-weather service must still be provided. In the details of alignment and grades, lesser standards may be used.

In connection with the improvement of secondary roads, the States, particularly in the North, should proceed to do as much work as is possible this fall using force account methods under competent engineering supervision. It is expected that the maximum use of hand methods and local labor will to an extent affect both the economy and efficiency of the results, but the problem is to give jobs. It is much better to give employment on work that will remain as a public asset in the communities, with the loss of some efficiency, than to provide relief in the nature of a dole.

Must Be No Starvation of Equipment Industry—In the conduct of contract work we must steer a safe course between machine and hand methods. In the effort to provide increased employment on the highways there must be no destruction or starvation of the equipment industry or loss of industrial employment that should be generated by such a widespread road building program.

The higher-type work on the Federal aid system and on the municipal projects must be done with the essential equipment, while a large opportunity is afforded for the use of hand labor methods on the secondary or feeder road projects.

In this legislation stress is placed upon the promotion of highway safety. Railroad grade crossing elimination is one of the best means for providing employment, particularly during the winter months, and probably no expenditure will provide a more permanent public asset. Sidewalks or footpaths along the suburban roads, particularly those adjoining the larger cities, must be taken seriously as a safety provision; likewise the closing of deep ditches with the drainage carried underground.

Numerous safety projects, involving largely hand labor methods, can be found in the widening of narrow roadways, the correction of alignment at bad curves, and the raising and widening of shoulders. Such work does not require extensive planning. It can be undertaken by direct labor methods and will provide much winter work, but such work does require highly competent engineering supervision.

Step toward Coordinating Transportation Services—Active steps are now being taken toward coordinating transportation services in several practical directions. Of chief immediate concern from the standpoint of highway construction are the studies which the Bureau is now making of the possible substitution of highway service for unprofitable branch rail lines to the extent of several hundred miles which the railroads have signified their desire to abandon. Further, recommendations have been made by the railroads for a very large mileage of feeder highways which they believe would be of advantage both in providing better combined transportation facilities

into rural sections from rail stations and also in developing more traffic for the railway lines.

These practical steps in the field of coordination are being actively pressed by the Bureau, not only in the interest of better transportation service for the public, but for the purpose of generating a greater degree of mutual confidence and cooperation on the part of those working in these two great transportation fields.

While this period of economic distress is largely responsible for the acute differences of opinion that have arisen between rail and highway commercial operators, it should be remembered that, after all, only a small percentage of the highway traffic is responsible for most of the adverse criticism that is made by supporters of the railroads.

There are a number of matters of sound public policy in which highway administrative officials are most highly interested in securing remedial legislation, as for example, the hours of continuous employment of commercial vehicle operators. No matter how theoretically correct traffic laws may be, they will only be practically serviceable when enforced by a sufficient and efficient highway patrol. The States which have not yet established such a force are negligent of both the lives and the property of their people.

The whole problem of rail-highway relations has peen competently explored during the past year by such agencies as the National Transportation Committee and the Joint Committee of Railroads and Highway Users. Further intensive studies are being made by the Federal Coordinator of Transportation, Mr. Joseph B. Eastman.

Undoubtedly there will be resulting legislation that should compose to a degree at least the present conflict of opinions. Such legislation, however, will have small limiting effect upon the use of the highways as a whole. Our efforts now ought to be directed toward the reorganization and revamping of our total transportation facilities against the time when these will all be needed to carry the normal commerce of the country.

In the directions which have been indicated, that is, in the provision of highway facilities to substitute for unprofitable branch railway operations and in the extension of feeder roads from rail systems, the Bureau hopes to have the cooperation of the States, since both of these general proposals appear to be in the public's interest.

Roadside Improvement—There is yet another field in which a large support and assistance is available in every part of the country. This is roadside improvement, consisting largely of finishing the roadsides to heal the scars of construction operations by the addition of seeding and well designed planting. A prominent place has been given improvements of this kind in the rules issued for the conduct of the recovery highway program.

It is universally recognized that a very large percentage of the total use made of the highways is for recreational and social pursuits. Reasonable expenditures for providing pleasant and beautiful roadsides are wholly consistent with sound public policy, particularly now since this type of work can be used to advantage in providing employment that reaches rather different classes than normal highway operations.

As highway executives, we will fail to realize the changed sentiment if we are longer content to build roadways only and neglect to improve and to plant the roadsides. The highway departments have been called upon to submit projects for roadside improvement on a reasonable mileage. A few miles in each state will not be considered a reasonable mileage of such work. It is hoped, with the cooperation of the States, that work of this character will be sufficiently extensive to accomplish an adequate demonstration of the tangible benefits to be derived from roadside improvement, to indicate the methods most appropriate for doing work of this character, and to establish the basis for an organization in each highway department which can carry forward continuously work of this character.

In this connection, wider rights of way, particularly for major highways, are necessary. The acquiring of land is slow and expensive. Most of the States need better laws for this purpose. Adequate planning for the future is dependent upon adequate right-of-way dimensions. Property values are lower and more easily secured now than they will be again in our generation. There will be opposition, but the result will be profitable to both the private owner and the public.

We can confidently expect that in the near future communities which have been relying upon well improved roadways to attract outside traffic, will be placing greater reliance upon beautiful highways. Already provision has been made for extensive work of this character in one or two States through the use of work relief labor, with other costs furnished by the use of highway funds. There is no reason why cooperative work of this character can not be greatly extended.

The Future Development of Highways—As a final thought, while the major accent has been placed upon the need for furnishing employment as widely and as rapidly as possible, the other principles here touched upon are highly important from the standpoint of the future development of our highways and the influence exerted by our highway organizations.

The planning of highways to meet both metropolitan and rural needs, the coordination of highway transportation with other forms, the inauguration of a national campaign for beautiful highways and the inauguration of widespread activities to do away with safety hazards of all kinds on our highways, these in themselves are worthy of our most intelligent efforts. They are all demands of the times. There is great public support to be had for the asking if we rise to these demands. Since the opportunity is now presented, we can rely upon future public support of these efforts. No other course should be considered.

The spirit of the moment is cooperation. In the National Administration there are many agencies which can be of great assistance to the State Highway Departments and which will also need the cooperation of these departments. Among those most closely related to our immediate problems are the Federal Emergency Administration of Public Works, the National Industrial Recovery Administration, the Federal Emergency Relief Administration, the U. S. Employment Service, the National Planning Board and the Federal Coordinator of Transportation. The activities of all of these organizations will have an intimate relation to, and considerable effect upon, the future of highway development and utilization.

The possibility of accomplishing results in these widespread activities will largely be measured by the confidence and cooperation that is generated throughout the nation. I have full faith in the reliance that may be placed upon the highway departments of all the States in advancing every proposal for meeting present conditions and building toward a better future.

Acknowledgment—The foregoing is an address presented at the 18th annual convention of the American Association of State Highway Officials, Milwaukee, Wis., Oct. 9-11.

Indian Jim Is At It Again

Mortar Bed Leveling Course in Place.

Indian Jim, the champion brick layer of the United States, is working on a brick resurfacing job of the McCarthy Improvement Co., Davenport, Ia., on Route 4, between Chatham and Auburn, south of Springfield, Ill. It is stated he lays 1,600 sq. yds. per day alone.

An interesting feature of this job is the organization of the working crew. This consists of three brick laying gangs, with only one mastic crew, one rolling crew, one culling crew and one filler crew. The accompanying illustrations show some details of the McCarthy contract.

Mastic Cushion Double Strike-off Roller.

Indian Jim in Operation.

Indian Jim Himself.

Indian Jim in Operation.

Straight-edging Mastic Cushion

Application of Asphalt Filler.

When Researching, Ignore the Boundaries of Science

By Halbert P. Gillette

ALTHOUGH it is generally admitted that there is a fundamental unity in nature, still most scientists continue to acts as if nature were divided into as many distinct realms as there are names for the different branches of science. Thus we have the geologists engrossed in records of changes in the earth's crust, and oblivious to astronomical discoveries. Conversely, the astronomers ignore the significance of geological evidence of cycles that indicate an astronomical origin. Meterologists see neither in geological cycles (clay varves, etc.) nor in biological cycles (tree rings, etc.) any facts by which a sound theory of weather cycles can be developed. The typical astronomer smiles incredulously when told that both clay varves and tree rings show correlation as to thickness with the 22.24 year sunspot polarity.

One of the greatest bars to scientific progress is, I believe, the prevailing indifference of specialists to the discoveries in branches of science other than their own. This attitude of indifference to knowledge in "other realms" springs from the false theory that nature has more than one realm. Man-made realms have been mistaken for natural realms. Lip-service is given to this generalization, but that is usually all. The actions of scientists belie their lip-service. Tonight your geological friend will admit that all nature is of one fundamental pattern. But tomorrow, and all the sequent tomorrows will find his nose buried in geological literature when he reads science. If you chide him for failure to read deeply outside his realm of geology, his reply will probably be that life is too short and scientific knowledge too vast to admit of much wide reading. In this statement he will be entirely right. But in his application of it he will be entirely wrong.

Scientific specialization is essential to successful research. But what do we mean by specialization? Is a man who studies all of geology a specialist? Far from it. Geology alone embraces such a great array of facts that no one man can become even slightly acquainted with them. Realizing this, many geologists devote a lifetime to facts relating only to a very narrow field, as for example, those relating to petroleum. So far, so good. What I am now advocating is investigation of facts in all man-made realms of science, to ascertain whether some of the facts are not applicable in solving the problems in which the specialist is engaged.

As an example let us take that realm of physics known as electron phenomena. Since electrons are widely distributed both in a free state and as parts of atoms, a petroleum geologist must admit that electrons may have had something to do with the formation of the anticlines or "domes" in which petroleum occurs. Let him grant that possibility and he must admit that it may be discovered that electrons are competent causes of the crustal warpings that have usually been attributed to the shrinking of the earth as a result of cooling. That cooling theory was devised generations before the electron was discovered. Being simple it appealed to many geologists as probable. Still it has never attained universal acceptance. In Encyclopedia Americana, under mountains, we read: "The cause of compression which produces such folds is by no means clear." If so any hypothesis as to warping of the earth's crust merits investigation.

In order to frame an electron hypothesis of crustal warping, it becomes necessary to learn what physicists have discovered as to the nature of the electron. Right here is where the typical geologist halts. "I am no specialist in electron phenomena," he apparently reasons. "Let electron specialists show me how electrons could warp the earth's crust and I will consider the matter."

Go now to the typical physicist who has specialized in electron theory, and suggest that he may be able to solve the crustal warping problem. Being a typical specialist, his reply will probably be: "Geology is not my specialty. I confine my researches to the behavior of electrons in the laboratory where I can control them."

Observe that the geologist depends mainly upon observation, whereas the physicist depends mainly upon experiment. Each thinks that he must not depart from his chosen field and his chosen methods of investigation. So between them they leave unexplored a crustal warping hypothesis that is at least plausible. Nor is this all. Let a civil engineer, for example, undertake to do what both the geologist and the physicist refuse to do, and what is their typical reaction? Either indifference or rather caustic criticism. " What does this civil engineer know about electricity? What does he know about geology? Let him stick to his road construction or whatever his construction specialty may be. Only specialists are competent to solve the problems in any given field."

Is it any wonder that the history of science is full of examples of important discoveries made by men who were not specialists in the ordinary acceptance of that term? In a broader sense most of those discoveries were specialists. Their specialty, at least for a time, was the research problem that they undertook to solve. Upon that problem they concentrated their efforts, often for years. They ignored no realm of science in which they thought there were facts that might aid in the solution. Knowing little about a given group of facts, they made themselves acquainted with those facts. They realized that it usually takes no great length of time to become very familiar with the published facts relating to a given problem.

In short they made themselves greater specialists than the so-called specialists, for while the latter were mulling over many problems they confined themselves to one problem.

The successful researcher is often a specialist who works on one problem at a time, but who does not confine himself to any man-made realm of science in seeking facts that will guide him to its successful solution. With increasing frequency will researchers adopt the research principle indicated by this last statement. They will cease giving mere lip-service to the generalization that all natural phenomena are basically alike, and will apply that principle in every research problem that they attack.

Resolutions Adopted by State Highway Officials

THE American Association of State Highway Officials at its 19th annual convention at Milwaukee, Wis., on Oct. 11 adopted the following resolutions:

Federal Funds for Highways Appreciated. Support Pledged to the National Recovery Act.—Resolved, That the American Association of State Highway Officials, first and foremost among its approving declarations, wishes to record appreciation of the funds supplied by the Federal government through the highway grants made available by the last session of Congress and desires to pledge its unqualified allegiance and full measure of support to the National Administration in carrying out the aims and purposes of the National Recovery Act relating to highways with all possible speed and with the utmost assistance to unemployment. Nearly all of the States are well along with the awarding of contracts under this program, and this Association now urges upon each State Highway Department the paramount importance of having the funds available completely under contracts at the earliest possible date, and, in any event, before January 1st next, to the end that the work so contracted may be completed insofar as is practical before July 1, 1934. Further we offer the facilities of the State Departments, with the allied direction and supervision of the Bureau of Public Roads, to the National Administration for an additional judicious use of Recovery Act money in highway building during the last half of 1934. We direct attention to the fact now becoming increasingly apparent that funds can be more quickly and effectively translated into the assistance of unemployment in this way than through any other plan of public expenditure.

Funds for "Feeder Roads"—Whereas, important secondary roads or feeder roads are becoming more and more a State obligation; be it

Resolved, That when a State Legislature adds this duty to a State, sufficient funds should be provided to take on the added obligation.

Diversion of Road Funds.—Whereas, the past year has seen an increasing disposition on the part of various States to use more vehicle license fees and funds derived from gasoline tax for other than highway purposes; therefore be it

Resolved, That all gasoline tax revenues and all motor license and registration license fees are essentially State revenues and should be expended by the State or under the supervision of the State or in cooperation with the National Government, upon some properly selected system of roads. Any other use of these funds may easily undermine a great national enterprise and is unsound governmental policy.

Amend Federal Highway Act.—Whereas, the Industrial Recovery Act as passed by Congress on June 13, 1933, made exceptions in the limitations of the Federal Highway Act approved November 9, 1921, as amended and supplemented, upon highway construction, reconstruction, and bridges within municipalities, and upon payments per mile which may be made from Federal funds; and

Whereas, the exceptions as noted in this act of 1933 only apply so far as emergency money made available under this said act; therefore be it

Resolved, That this Association recommends to the Congress of the United States that the Federal Highway Act be amended so as to remove the cost per mile limitation and limitation on construction within cities and municipalities.

Advocate Regular Federal Aid.—Whereas, the usual Federal aid granted the several States under the provisions of the Federal Aid Act Approved November 9, 1921, was suspended for the fiscal year 1933-1934; and

Whereas, the granting of such regular funds has resulted in great benefits in the orderly planning and execution of road programs; and

Whereas, it is necessary and desirable that these programs be logically continued; therefore be it

Resolved, That this association petitions and requests the Congress of these United States to make appropriations of regular Federal aid to the States in the amount of not less than $125,000,000 per year for the two-year period beginning July 1, 1934, and in addition thereto for each year the usual relative grants for roads through national forests and public domain.

State Laws Should Not Circumscribe Engineering Policies.—Whereas, economic conditions are changing rapidly and the science of highway engineering is constantly advancing, necessitating flexible administrative and engineering policies as a means of meeting successfully changing conditions and bringing rapidly into current practice the results of engineering experience and research; and

Whereas, there has developed a tendency to incorporate in the statutes subjects which are primarily administrative or engineering in character rather than legislative, with resulting crippling of administrative and engineering initiative; therefore be it

Resolved, That legislation should establish broad and flexible administrative and engineering policies which will safeguard the public interest, but which will at the same time permit highway administrators and engineers to meet changing conditions without legal restrictions as to road type, width, design, cost or other technical principles.

Policy Concerning U. S. Numbered Roads.—Whereas, the system for designating, numbering, and marking interstate and other through routes for long-distance travel, as established and carried out by this Association, has in the past proved itself sufficient and adequate to serve the convenience of the traveling public, and continues to prove its value, especially in the Middle Western States during the period of the Century of Progress, as a most satisfactory method for numbering and mapping routes of first importance; now, be it

Resolved, That this Association reiterates its purpose to continue the policy of numbering and marking routes as now practiced; and recommends for consideration by the Executive Committee the further consolidation of short sections of numbered routes now existing into long connected routes, the discontinuance of alternate routes bearing alternate numbers so far as this may be practicable, the assignment of new numbers to such alternate routes, and the disapproval of requests for new designations except when the roads are actually in condition for travel, and then only when the routes are interstate in character or important connections to interstate routes; and be it further

Resolved, That this Association strongly recommends to all the States that no support be officially given to any proposal to identify by a historic, local, personal, or other name, any highway whatsoever; and be it further

Resolved, That the standard signs, signals, and markers as promulgated by this Association are hereby recommended to all the States for use in all public highways, to the exclusion of all other official signs, signals, and markers.

Regulation of Bus and Truck.—Whereas, the improvement of the automobile, the increasing operation of the common carrier bus and truck engaged in interstate and other transport, and the certainty that the competing railroads will soon be operating new and more rapidly moving equipment are developing a situation that will require much new legislation on the part of the National Government as well as by the States; therefore be it

Resolved, That the ideal situation will prevail if and when each sort of transport enjoys the traffic it can secure on merit and when each bears a just and fairly reckoned burden of taxation. National legislation governing the operation of the bus and the truck should be perfected and enacted into laws in the approaching session of the Congress. The States also will soon largely add to the volume of their legislation governing the bus and the truck. Uniformity is highly desirable. The Bureau of Public Roads may render an important service by continuing its study of this problem and by suggesting fair and well considered legislation. State Highway Departments may assist.

All Funds Borrowed Under N. R. A. for Roads Should Be Expended Through State Control.—Whereas, a considerable number of States and political subdivisions are contemplating undertaking additional highway work by supplying State or local funds to the extent of 70 per cent of the cost of such work or borrowing such amounts from the Federal Government and obtaining a Federal grant for the remaining 30 per cent; therefore be it

Resolved, That all the highway work undertaken with funds supplied from State sources or borrowed from the Federal Government, for which State revenues are pledged as security, shall be undertaken under the supervision of the State Highway Departments and under the general procedure established for the administration of Section 204 of the National Industrial Recovery Act, in order to secure coordination of effort and result.

Clearing and Grubbing with Logging Power Unit

The contract of C. G. Wills & Sons, Los Angeles, Calif., for Section C1, Route 4, Tioga Road, Yosemite National Park, includes a considerable amount of clearing and grubbing which has to be done under difficult conditions. The contract involves 57 acres of clearing, all of which was required to be done in such manner that the terrain adjacent to the right of way was left in natural condition. This provision means that removal of debris, stumps, and so forth, must all be confined to the actual right of way, and that there be no tractor marks, bruises, gouges, scratches or broken limbs left in the standing timber. All bunching, falling, stumping and burning is thus confined to a narrow area and often the ingenuity of the workmen and the capacity of equipment are taxed to accomplish the desired result without damaging the timber off the right of way.

Practically all the clearing is being done with the Le Tourneau logging power unit. The smaller drum and line of the unit, with its 920 ft. of ½-inch-cable, is used most. With this trees are uprooted and bunched and the down-timber dragged long distances at high speed, the line speed of this drum being 200 ft. per minute. In one instance this ½-in. line was run to a pine 30 ins. through at the butt, being fastened 30 ft. from the ground, and after three or four pulls, swaying the tree, the pine was completely uprooted. With the same line the tree was then pulled into a fire for burning, the entire operation of removing the tree taking less than ten minutes.

The heavy line and large drum on the power unit are being used for pulling out broken stumps, moving heavy boulders and the slower work of clearing generally. For this, its 53,000 lb. line pull fits it admirably.

The unit delivers ample power regardless of the fact that the work is being done at elevations ranging from 8,000 ft. up to 10,000 ft., with resultant diminuation of engine power in the tractor.

Pulling Out Broken Stumps with a 53,000 lb. Line Pull

Reflecting Buttons Improve Highway Warning Signs

"Stop," "Slow," curve warnings, and other highway signs can be read more quickly and certainly by daylight if they have a background of "Federal yellow" with black lettering. At night, reflecting buttons set into the lettering and bordering the sign improve readability enough to more than make up for the slight reduction in readability they cause by day. Reflecting buttons about three-quarters of an inch in diameter, set with centers at least an inch apart, so that the area of the buttons does not amount to more than half the area of the black marking that forms the letters, are more effective than either larger or smaller buttons.

These are some of the conclusions resulting from exact scientific measurement of the time observers require to read and recognize various types of signs, according to a report by engineers of the Bureau of Public Roads and the Bureau of Standards. The report gives details of the timing equipment and results of tests with typical observers, using the apparatus under conditions similar to actual driving. The testing device, devised especially for this work, included a pendulum which regulated opening and closing shutters in such a way that observers viewed the area where the sign was shown for a second or for a precise fraction of a second. In this short time the eye had to find and center on the sign and recognize the characters so that the observer could report the wording.

The tests confirmed previous tests showing the value of "Federal yellow" as background for a sign. It stands out in contrast to almost any background and the attention centers quickly on the signed and its message. In daylight the investigators found, for example, that a 200 ft. almost 100 per cent of the observers could in 0.8 of a second pick up and identify a yellow sign with "Stop" in letters 6 in. high and with strokes of letters 1 in. wide. At 350 ft., however, less than 80 per cent recognized it in 0.8

of a second. At night about 70 per cent read the same sign correctly at 200 ft. when lighted by standard motor headlights. Beyond 200 ft. the readings fell off rapidly, but when the same sign was equipped with ¾ in. reflecting buttons nearly 90 per cent of the observers read it correctly at 200 ft. The ¾ in. buttons made sign distinctly more readable than either the 0.95 in. or the 0.58 in. buttons, although the smaller buttons gave a somewhat more brilliant reflection. Buttons should not be set too close together, the tests indicated, as this reduces readability in daylight.

On curve warning signs the readability was increased by including arrows pointing the direction of the curve. These enabled observers to identify the signs, but other symbols hindered instead of helping. Dictinctively shaped warning signs outlined with reflecting buttons near the border are recommended as "worthy of further development."

Commenting on the standard yellow, or "Federal yellow," the investigators say: "In addition to the greater readability of the legend the yellow background has a greater signal value, being more arresting to the average observer, and more conspicuous by contrast with the average natural or artificial background. By the adoption of a definite shade and hue it should be possible to prohibit the use of this distinctive shade for any roadside advertisements or signs other than official highway signs."

▼

Preventing Segregation of Coarse Aggregate

A study of the segregation of coarse aggregate and the use of divided coarse aggregate for its prevention has been made by the Bureau of Materials, Division of Highways, Illinois Department of Public Works and Buildings. The results are summarized as follows in the October Highway Research Abstract, issued by the Highway Research Board of the National Research Council:

In spite of the fact that since all shipments of aggregate are inspected at the source, each carload may be assumed to contain aggregate within the specification limits, it was shown by 19,957 sieve analyses made on paving projects, that 13 per cent of the coarse aggregate exceeded the gradation limits of the specification. In the case of structure concrete 4,905 sieve analyses showed that 33.8 per cent of the coarse aggregate exceeded the specified gradation limits. The crushed stone aggregate was found to segregate slightly more than gravel.

No attempt was made to study the degree of segregation, but it is evident that some segregation occurs on nearly every job, and that on certain jobs it may become so aggravated as to cause serious difficulty in placing and finishing the concrete.

In order to investigate the possibility of improvement by the use of coarse aggregate shipped in two sizes, arrangements were made for shipping crushed stone coarse aggregate for two miles of a 4¾ mile section in two sizes, 2 in. to 1 in. and 1 in. to ¼ in. The coase aggregate for the other 2¾ miles was the same except that it was shipped in the regular manner. In all other respects the procedure was the same on both sections.

Prior to beginning work on the experimental section some of the divided aggregate was used in completing work on an adjoining project where on account of coarsely graded fine aggregate and stock pile segregation of coarse aggregate considerable difficulty was encountered in placing and finishing. When the divided aggregates were used in combinations of 60 to 50 per cent of the larger size to 40 to 50 per cent of the smaller size the difficulty in working and finishing the concrete disappeared. The best results with this coarsely graded fine aggregate were secured with the 55-45 coarse aggregate combination.

On the experimental project a differently graded fine aggregate was used and the best combination of the two sizes of coarse aggregate was found to be 60 per cent of the large to 40 per cent of the small. The workability of this combination was found to be so much better than that of the regular undivided material that an increase of 10 lb. of aggregate per bag of cement could be used without notable difference in the workability and finish of the resulting concrete.

Sieve analyses of samples from various places in the stock piles of separated materials showed that the segregation in these piles was negligible.

Some data on the uniformity of the concreting resulting from the use of the divided coarse aggregate are shown in Tables I, II and III.

TABLE I—SIEVE ANALYSES OF COARSE AGGREGATE OF THE 60-40 COMBINATION USED IN INDIVIDUAL BATCHES, COMPUTED FROM SIEVE ANALYSES MADE ON SAMPLES TAKEN FROM EACH OF THE TWO HOPPERS

Test No.	Passing Sieve—Per Cent 2 in.	1½ in.	1 in.	¾ in.	½ in.
1.....	100	90	44	35	19
2.....	100	88	52	36	14
3.....	100	81	45	36	14
4.....	100	87	50	36	21
5.....	100	78	42	38	18
6.....	100	92	57	42	20
7.....	100	88	52	34	15
8.....	100	96	45	34	16
9.....	100	87	53	32	13
Average.....	100	87	49	36	17

TABLE II—SIEVE ANALYSES OF COARSE AGGREGATE OF THE 60-40 COMBINATION SEPARATED FROM FRESHLY PLACED CONCRETE

Test No.	Passing Sieve—Per Cent 2 in.	1½ in.	1 in.	¾ in.	½ in.
1.....	100	97	73	54	38
2.....	100	81	51	30	23
3.....	100	74	44	37	20
4.....	100	87	50	35	18
5.....	100	87	60	42	24
Average.....	100	85	56	40	25

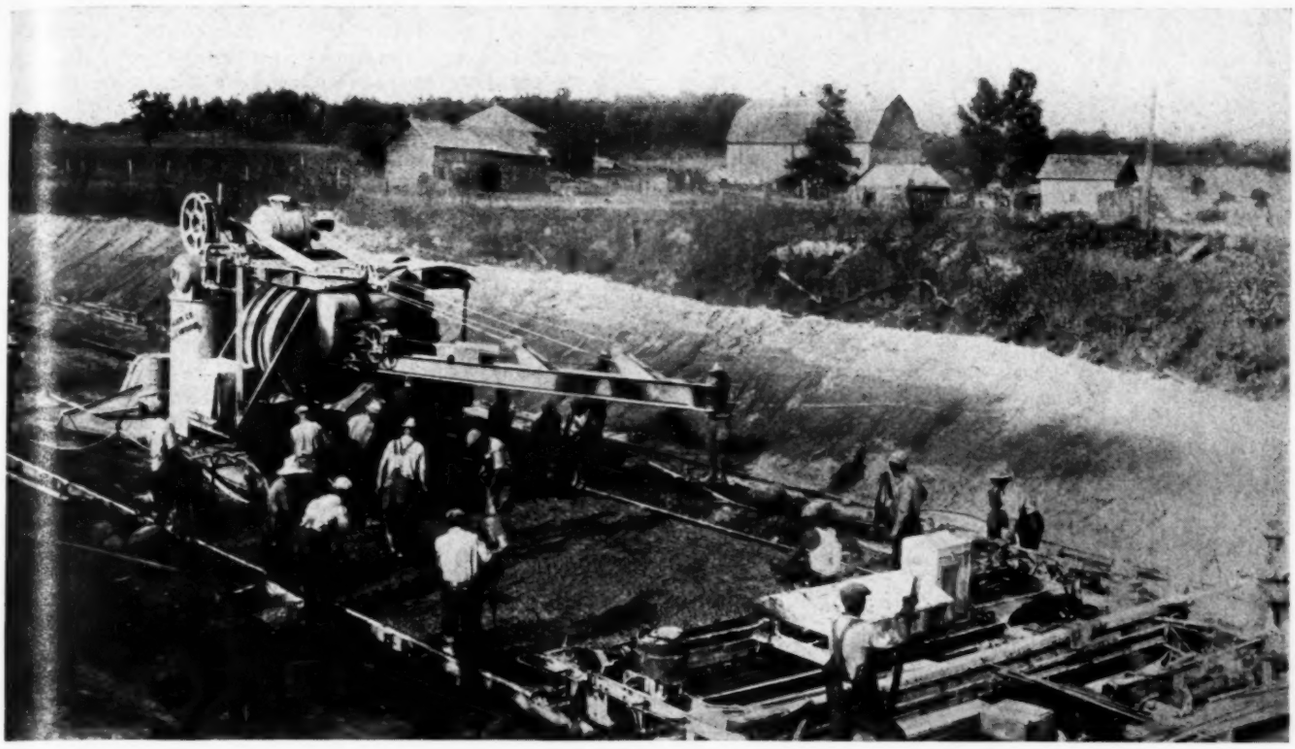
TABLE III—FIELD ANALYSES OF FRESHLY PLACED CONCRETE CONTAINING COARSE AGGREGATE OF THE 60-40 COMBINATION—QUANTITIES GIVEN ARE PER BAG OF CEMENT

Test No.	Water (Gallons)	Fine Aggregate (Pounds)	Coarse Aggregate (Pounds)
1.....	5.18	212.3	308.6
2.....	5.53	211.2	274.0
3.....	5.48	213.9	296.5
4.....	5.26	207.3	310.8
5.....	4.62	222.9	375.0
6.....	4.82	196.6	335.0
7.....	5.14	204.6	300.0
Average.....	5.15	209.8	314.3
Actually used...	5.16	215.0	349.0

According to the authors, "the results described in this report indicate that the use of divided coarse aggregate is a distinct aid in preventing segregation. There is a possibility also that a large amount of coarse aggregate may be used per bag of cement, which could also effect a saving in the amount of cement used."

▼

SIMPLIFIED PRACTICE RECOMMENDATION COVERING VITRIFIED PAVING BRICK REAFFIRMED.—Simplified practice recommendation No. 1-32, covering vitrified paving brick has been reaffirmed, without change, for another year by the standing committee of the industry, according to the division of simplified practice of the Bureau of Standards. A survey of the 1932 production of vitrified paving brick revealed that 81.5 per cent of the total shipments conformed to the six sizes listed in the simplified practice recommendation.



"M-U-D"

By Hugh B. Werner

This is a song of toil and grime
Where the slab is laid in a race with time.
From dawn till dark the mixer roars,
The skip goes up and the bucket pours,
And the bull-floaters cry out
"M-u-d!"

A hundred men in the scorching heat
With aching backs and weary feet—
Muck and spade and float it down
And finish the slab from curb to crown
While the bull-floaters shriek for
"M-u-d!"

The inspector watches all intent
Through the din and dust this wild foment;
The foreman winks and the mixer-man nods
The inspector stumbles over the clods—
And the bull-floaters mock with
"M-u-d!"

The paper's torn—the steel's awry;
The tail-blade rides—the grade's too high;
The shoulder clods disturb the scales
And the yield-test takes three extra pails,
And the bull-floaters wail for
"M-u-d!"

One batch too wet—the next too dry;
The back screed slips—the crown's too high;
The felt in the joints is not laid straight—
The burlap wagon is broke or late,
And the bull-floaters groan for
"M-u-d!"

After the sunset and evening shade
When the header-board's in and the burlap's laid,
The inspector has wearily counted the score
And made out a hundred reports no more—
The bull-floaters still echo
"M-u-d!"

Potential Saving from Grade Reduction

ONE of the more difficult problems in highway economics is estimating the potential saving that would result from grade reductions. A practicable and rational approach to this problem is given by Thomas R. Agg, Dean of Engineering, Iowa State College, in a 11-page paper, "Estimating the Economic Value of Proposed Highway Expenditures," in the September Proceedings of the American Society of Civil Engineers. That portion of his paper relating to grade reduction follows:

Minor grade reductions may be accomplished by cutting and filling without relocation, but major grade reductions, especially on long hills, are usually accomplished by a combination of relocation and cutting and filling. The changes in grade that can be accomplished by cutting the summits and filling the sags without relocation usually have little economic value although exceptions may be noted. This problem is complicated still further by the part that the operating characteristics of the vehicles that comprise road traffic are so variable that there is no such thing as a single economic grade. The engineer is forced to compromise on grades that are feasible within the limits of the topographical conditions surrounding a project. A practical and rational approach to this problem may be accomplished, as follows:

1.—Determine the total rise and the total station length of the grade which it is proposed to reduce.

2.—Determine the corresponding two factors for a proposed grade improvement which will permit ascent in high gear for most of the traffic.

3.—Assume 4 percent to be a safe coasting grade for the vehicles that use the road, and determine the excess rise on the proposed plan over that which would be provided by a 4 percent grade of the same length.

4.—Estimate the annual tonnage of traffic using this road. A conversion factor can be applied to the estimated volume of traffic to convert it to a tonnage basis. For most projects it is safe to assume that this traffic is divided equally between the two directions.

For purposes of these computations it may be assumed that a gallon of gasoline weighs 5.9 lb., that each pound of gasoline tests 19 000 Btu, that each British thermal unit is equivalent to 777 ft.-lb., and that the average thermal efficiency of the engines in the vehicles that make up the traffic is 15 percent. With this as a basis, the various relationships involved may be set up in the form of an equation for computation purposes, as follows:

Let H = height, in feet, of existing summit above the sag;
H_1 = height, in feet, of proposed summit above the sag;
H_2 = height, in feet, of summit of a 4% grade of stationing equal to proposed grade;
M = low-gear factor for the existing grade;
C = cost of gasoline, in decimal of a dollar per gallon;
S = annual savings by reducing grade; and
T = annual tonnage of traffic over highway.

Then:

$$S = \frac{2\,000\,[\frac{1}{2}T\,(M\,H - H_1) + \frac{1}{2}T(H_1 - H_2)]\,C}{19\,000 \times 777 \times 0.15 \times 5.9}$$

$$= 0.0015CT[(MH - H_1) + (H_1 - H_2)] \ldots\ldots (1)$$

The foregoing computations will show the annual saving by the grade reduction. If this grade reduction is accomplished by increasing the length of the road, then the saving computed by Equation (1) must be reduced by the extra cost of distance.

A word with reference to the factor, M, which is designated as the low-gear factor for the existing grade, may not be out of place. If an existing grade were such that a vehicle could ascend in low gear, there would be no economic reason to change that grade unless the change resulted in a saving in transportation cost. As a matter of fact such a saving does result, due to the decreased time required for the ascent, and to the decreased cost of vehicle operation when the ascent can be made in some gear faster than "low." Therefore, the factor, M, represents the quotient obtained by dividing the cost of ascending an existing grade with the gear that would have to be used, by the cost of making the ascent if it could be made in high gear, at high-gear speed and high-gear operating efficiency. It can only be determined experimentally.

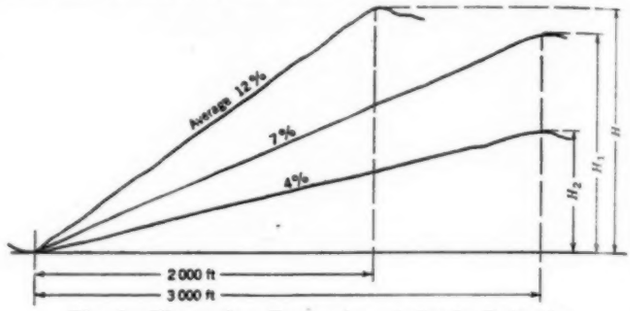


Fig. 1—Illustrating Economics of Grade Reduction

Example of Computation of Value of Grade Reduction—Let it be assumed that on a surfaced road (Fig. 1) an existing grade 2,000 ft. long has an average 12 percent grade, and, consequently, a rise (H) of 240 ft., and that it is to be changed to a 7 percent grade which will require relocation that will give 3,000 ft. of grade with a rise (H_1) of 210 ft. The equivalent of 3,000 ft. of 4 percent grade would have a rise (H_2) of 120 ft. Suppose that the annual traffic over this grade is estimated at 4,000,000 tons and that the average price of gasoline is 19 ct. per gallon. The factor, M, in this case may be taken at 1.4. The annual saving by this grade reduction, therefore, would be, as follows:

$S = (0.0015)\ (2{,}000{,}000)\ (0.19)\ \{\ [(240 \times 1.4) - 210] + [210 - 120]\ \} = \$123{,}120$

Let it be assumed that the 4,000,000 tons of traffic using this highway consist of 3,000,000 automobiles at an average weight of 1 ton, and 250,000 trucks at an average weight of 4 tons. The cost of the extra travel to the 3,000,000 automobiles, at 2½ ct. per mile, would be $75.000 per year. The cost of the extra travel to the 250,000 trucks, at 5 ct. per mile, would be $12,500 per year, or the total cost to the traffic of the extra travel made necessary by lengthening this grade would be $87,500. The saving to traffic on account of the grade reduction was $123,120. Deducting from this the extra cost of the extra distance, or $87,000, leaves the net value of the saving to traffic by this grade reduction as $35,620 per annum. This may be capitalized on whatever basis seems appropriate, but in view of the conditions that surround the highway transportation field, it is well to be conservative. Suppose it were to be capitalized on a 4 percent basis, and amortized within a period of 20 years. The expenditure that could be justified on economic grounds for this work would then be the present worth of an annuity of $35,620 continuing for 20 years at 4 percent rate of interest, or about $485,000.

The Origin and Composition of Metamorphic Rocks

By D. G. Runner
Assistant Materials Engineer, U. S. Bureau of Public Roads

In practically all branches of engineering work, problems involving the use of rock are constantly being encountered. It is of fundamental importance to the engineer to have a knowledge of the commonly occurring types of rock, their origin, composition, texture, mode of occurrence and other general properties. Rocks vary greatly in their density; ability to withstand atmospheric weathering; hardness, which in turn has an effect upon the rate of drilling; and composition as determined by the arrangement of their component minerals.

It is the purpose of this article to explain something

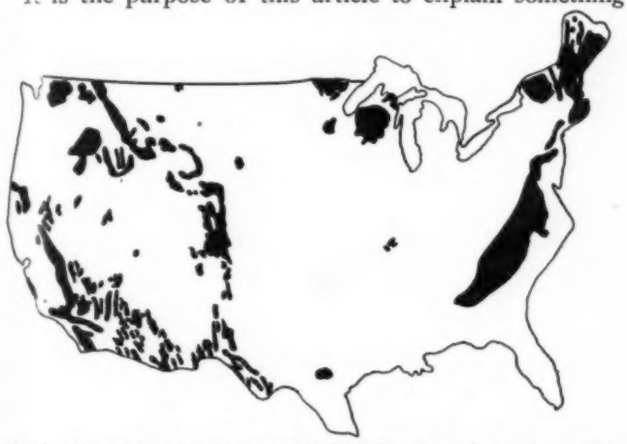


Fig. 1—Map Showing Geographic Distribution of the Crystalline Rocks Mainly Granites and Gneisses. (From G. P. Merrill, Stones for Building and Decoration.)

of the origin and composition of metamorphic rocks. This subject, it is believed, needs to be presented in a manner, as free as possible, from the extreme technical phraseology so commonly used in discussing rocks. A rock is usually defined as an aggregate of one or more minerals. Geologically, it may include loose deposits of sand, gravel, as well as the more compact masses such as sandstone, granites, limestones, etc. Metamorphic rocks form a large percentage of the surface rocks of the earth's crust, and it is hoped that this discourse will help the engineer to understand the origin and composition of this group of rocks.

Geographic Distribution of Crystalline Rocks.—It might be well at this time to discuss the areal distribution of gneisses and associated crystalline rocks in the United States. Figure 1 illustrates in a general way how these rocks follow the main mountain chains. With the exception of small areas in the north central and south central regions, the crystalline rocks are found in the Appalachian and Rocky Mountain systems. This is due to the fact that mountain building and its resultant faulting and folding alter the existing strata into metamorphic rocks. In a broad sense, any rock that has been altered by some means, either chemical or physical, is a metamorphic rock. Although the metamorphic group of rocks is closely allied with the igneous and sedimentary groups, it exhibits so many independent features that it should be treated as a separate unit.

Pre-existing rocks, either of igneous or sedimentary origin, may be changed by heat, pressure, or combinations of both. In a large sense metamorphism may be divided into two large classes, namely, contact and regional. The former class consists of rocks which have had their original texture and chemical characteristics changed by the intrusion of a mass of igneous material. In other words the change has been caused largely by heat, frequently in combination with chemical action of liquids and gases. On the other hand, the regional metamorphism caused by mountain foldings, is the result of downward pressure of overlying rock or lateral thrusts of the earth's crust. This lateral movement causes faulting, folding, or mashing of the rock formations.

Thermal or Contact Metamorphism.—Figure 2 illustrates what is meant by thermal or contact metamorphism. A molten mass of granite or other igneous mateial is introduded into a formation of sedimentary rocks. The heat, liquids and gaseous vapors emanating from the molten mass alter the original constitutents of the sedimentary rocks along the zone of contact. The sandstone has been changed into quartzite, the shale to hornstone and the limestone to marble. This alteration may vary in intensity and extent. In many cases the original

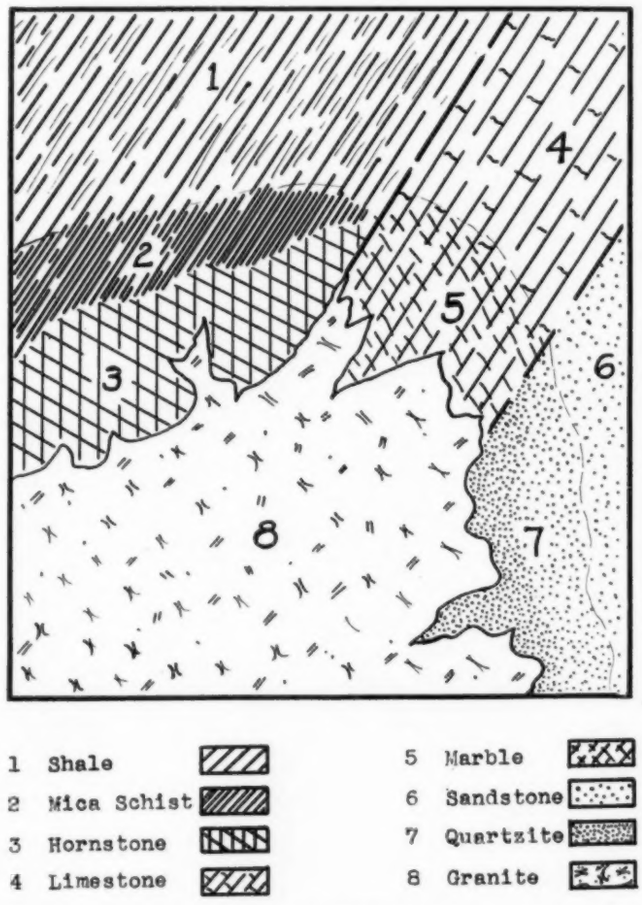


Fig. 2—Diagrammatic Section Illustrating the Contact Metamorphism of Existing Rock by an Intruding Mass of Igneous Material (Scale 1 in. = 10 miles).

rock may still be identified after metamorphism, while in others, all traces of the original character have been entirely obliterated.

As stated previously, lateral thrusts of the earth's crust produce folding and faulting of the strata, which in turn modifies the original minerals in the existing

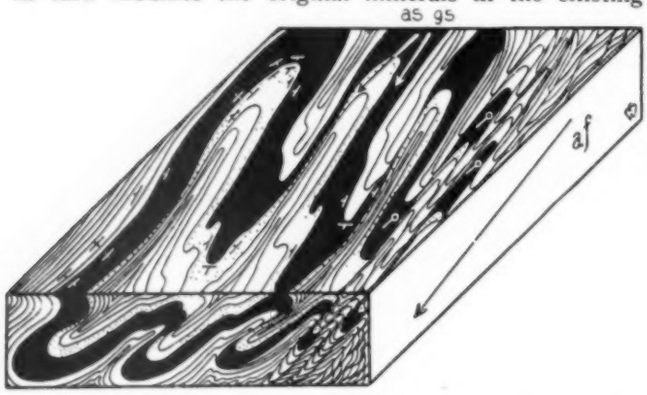


Fig. 3—Block Diagram Showing the Effect of Compressive Crustal Movement Upon Horizontal Strata (After Wegmann).

rock beds. Figure 3 illustrates how extreme folding of strata causes fracturing and mashing of the rock. The earth's crust has suffered great compressive force and has obtained relief by wrinkling or folding the strata. The greater the shear and compressive action upon the layers of rocks, the greater the metamorphism. Figure 4 shows breakage lines and jointing in a granite outcrop, induced by pressures set up in crustal movements.

Types of Metamorphic Rocks.—The pressure-temperature diagram shown in Fig. 5 gives a rapid survey of the different types of metamorphic rocks. By reference to Fig. 5, it is seen that metamorphism caused by the contact action of hot masses of igneous material on sedimentary rocks (i.e., thermal metamorphism and contact metamorphism) takes place at high temperature and low pressure. The regional metamorphism which gives rise to crystalline schists and gneisses always takes place under higher pressure, although the temperature may be lower than in the case of contact metamorphism. Since both temperature and pressure increase with the depth, it is obvious that relatively low pressure is accompanied by low temperature, and high pressure with higher temperature.

Classification of Metamorphic Rocks.—The following

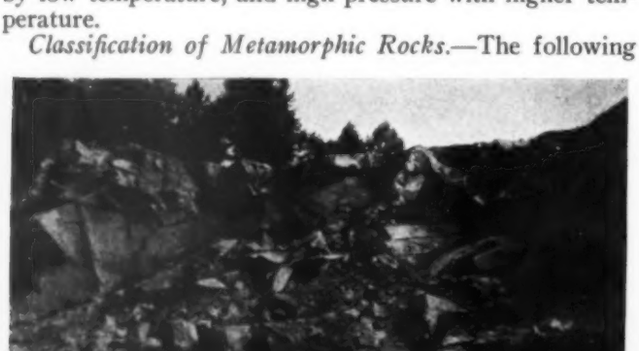


Fig. 4—Showing Jointing and Lines of Breakage in Outcrop of Granite.

arrangement is useful in classifying the metamorphic rocks:

1. Mylonites—which have undergone metamorphism due to mechanical processes. Chiefly crushing and cleavage, etc., with a minimum amount of recrystallization.
2. Hornstones—which have been recrystallized by heat, with no serious addition of material. (Contact metamorphism.)
3. Crystalline schists—which have been recrystallized under pressure. (Regional metamorphism.)

The term mylonite is applied in a general way to all metamorphic rocks which are distinguished by crushing without any change in mineral composition. They are usually composed of finely divided "rock flour" and rock fragments from the original body of rock. These rocks have a banded appearance and are fairly cleavable. Oftentimes this "mylonitic" material is partially cemented by the heat generated in regional crustal movements. At other times silica or other substances from percolating waters will enter the cracks formed during movement, and cement the material into a semi-consolidated condition. When the pressure developed by crustal movement becomes intense, the matrix (finely divided rock flour) may begin to recrystallize, and to develop a micaceous or chloritic appearance. In this way intermediate stages are formed between mylonites and crystalline schists of the upper zone.

Hornstones are the products of thermal or contact metamorphism, and are usually developed in the contact regions near large intrusive igneous bodies. These rocks are generally gray, lustrous, dense and fine-grained.

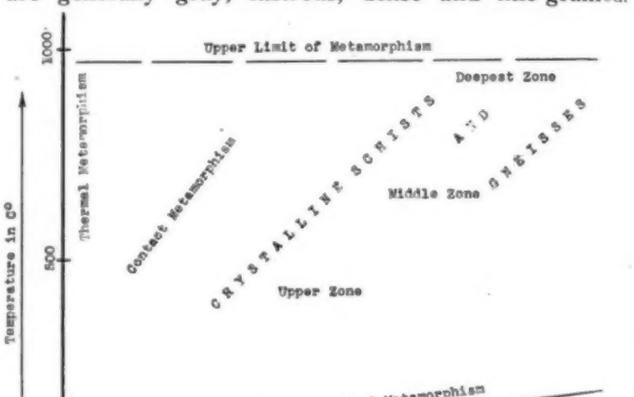


Fig. 5—Pressure-Temperature Diagram for Metamorphic Rocks.

Hornstones are distinguished from crystalline schists by texture, and usually require the microscope for detailed study. The schists are commonly more coarse-grained. Most sedimentary rock altered by contact metamorphism may be called hornstone, but very lime-rich sediments which, with recrystallization usually give rise to rather coarse-grained rocks, are better known as marble. The most common types of sedimentary rocks (with the exception of conglomerate, arkose, and dolomite) can be grouped as shown in the diagram of Fig. 6. Calcareous and argillaceous rocks rather than arenaceous are particularly sensitive to thermal change and develop the hornstone characteristic in the vicinity of igneous masses.

As indicated in the pressure-temperature diagram (Fig. 5) the crystalline schists and gneisses are formed under great pressure and stress, such as occurs at great depths and beneath mountain faulting. There can be no hard fast line drawn between gneisses and schists. In fact gneisses may shade into schists under certain conditions of pressure and temperature. Gneisses[1] are a medium or coarse-grained crystalline rock possessing some form of parallel structure due either to the uni-

[1]From "Report of the Committee on British Petrographic Nomenclature," 1920.

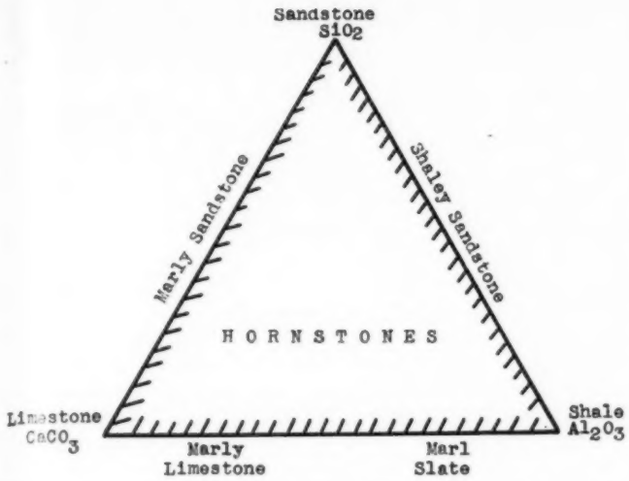


Fig. 6—By Intrusion of Igneous Masses, These Rocks Are Changed Into Massive Hornstones.

form orientation of certain tabular or prismatic minerals, or to the presence of wavy discontinuous surfaces indicating a lenticular structure, or of bands of varying mineralogical composition which retain their continuity and parallelism throughout a considerable mass of rock (banded gniess). The term gneiss, when used without qualification, should imply a rock of granitic composition but not necessarily of igneous origin. Schists[1] (crystalline schists) differ from gneisses in being of finer grain, and in possessing a well-marked tendency to split into thin layers, except when puckered or folded by movement subsequent to the development of schistosity. The term carries with it no mineralogical connotation. Composite names for gneisses and schists are based mostly upon a characteristic mineral present, such as; chlorite schist, hornblende schist, talc schist, etc., or biotite gneiss, garnet gneiss, sericite gneiss, etc.

Development of Metamorphic Rocks.—In order to show the development of metamorphic rocks from loose sediments and also from igneous rocks, the following tables are given. By processes discussed in the preceeding paragraphs the sediments and igneous rocks are altered to their metamorphic equivalents.

Sedimentary Rocks and Their Metamorphosed Equivalents[2]

Loose Sediments	Compacted Sedimentary Rocks	Metamorphic Rocks
Gravel	Conglomerate	Schist & gneiss
Sand	Sandstone	Quartzite
Silt & Clay	Shale	Slate, schist & gneiss
Lime deposit	Limestone	Marble

Igneous Rocks and Their Metamorphic Derivatives[3]

Igneous Rocks	Metamorphic Rocks
Feldspathic rocks such as granite, syenite, felsite, etc.	Gneisses of different kinds
Ferromagnesian rocks such as gabbro, dolerite and basalt	Amphibolite, hornblende gneiss, eclogite

As stated in the opening paragraph, rocks vary greatly in their respective ability to withstand physical and chemical tests. The average physical properties of igneous, sedimentary and metamorphic rocks, as determined in the laboratory of the United States Bureau of Public Roads, are shown in Table 1. The values indicated may not be true for all samples of the rock type shown but may be considered as average.

[1]Modified from Reiss & Watson, "Elements of Engineering Geology."

[2]Suggested by Dr. T. F. W. Barth, Geographical Laboratory, Washington, D. C.

TABLE 1—AVERAGE PHYSICAL PROPERTIES OF ROCK[1]

Rock	Classification	Weight lbs./C.F.	Per cent of wear	Hardness	Toughness
Granite	Igneous	167	4.3	18.3	11
Syenite	do	171	3.3	18.3	15
Diorite	do	179	3.0	18.2	17
Gabbro	do	185	3.0	17.7	14
Limestone	Sedimentary	165	5.0	14.1	9
Dolomite	do	170	5.5	14.9	9
Sandstone	do	164	6.2	14.4	10
Chert	do	159	9.4	18.2	12
Gneiss	Metamorphic	172	4.9	17.4	10
Schist	do	180	4.7	16.6	13
Amphibolite	do	188	2.8	17.5	19
Quartzite	do	169	3.2	18 8	18

[1]Data selected from The Results of Physical Tests of Road-Building Rock, United States Department of Agriculture Miscellaneous Publication, No. 76, 1930.

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Revenues in Canada from Automotive Sources.—Receipts from motor vehicles in 1932 in Canada amounted to $56,718,000, an average of $50 per vehicle. The provinces collected $21,126,271 in registration fees and $27,083,316 in gasoline taxes. The Dominion Government received $4,508,471 in import duties and excise taxes. The sales tax on motor cars amounted to $2,500,000. The duty on imported gasoline was estimated at $1,500,000. The estimated population in 1932 was 10,506,000, and the total motor vehicle registration was 1,114,403.

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$76,500,000 Highway Plan for Buenos Aires Province Approved.—According to the Oct. 16 issue of Automotive World News of the U. S. Department of Commerce, the Direccion de Vialid (National Highway Bureau) has approved the highway plan for the Province of Buenos Aires calling for the expenditure of 180,000,000 paper pesos. (At par the paper peso equals $0.425 U. S.) This sum will be distributed in more or less equal parts over three zones of this province, one being in the neighborhood of the city of Buenos Aires and the other two in the northern and southern zones of the province. The plan is to build a total of 3,140 miles of highways of which 1,190 miles will be paved, 1,580 miles improved and 487 miles of ordinary dirt roads. Definite roads are planned for construction or improvement within the first five years and the balance within the fifteen year period. During the same time in addition to the main roads the province will undertake to construct about 12,000 miles of short roads of access to various towns and main roads. The board also decided on the construction of various roads giving access to the city of Buenos Aires, so as to relieve congestion on existing routes.

How the $400,000,000 Federal Aid Highway Appropriation Will Be Spent

THE various state highway departments now have their plans well advanced for the work they will carry out under the $400,000,000 appropriation for the emergency construction of highways. Up to Oct. 23 a total of 2,950 of these N. R. federal aid projects had been approved, the amounts obligated by them being $175,286,000. On the above date a total of 1,965 projects had been awarded.

Interesting details of how the various states will expend their allotments from the federal appropriation were given by the four district vice presidents of the American Association of State Highway Officials in reports presented at the annual convention of the Association held at Milwaukee, Oct. 9-11. The statements set forth the conditions on Oct. 1, 1933. The matter following is taken from these reports.

First District, By H. E. Sargent, State Highway Commissioner, Vermont

By the terms of the act, the total allotment for the district is $76,033,870. Atlhough this money will build many miles of very necessary roads, its greatest immediate accomplishment, of course, will be in providing employment for thousands of jobless men, and incidentally lessening the tax burden on local governmental units which has been increased for relief.

The National Recovery work of most states is so interwoven with programs of their own, that it is impossible to make a definite separation. In many states, due to new problems created by the NRA requirements, the programs are not at this date complete, or are in the process of revision. I am presenting, however, a summary of the information I have collected from the 12 states in the northeast section of the country.

Maine—The allotment to this state is $3,369,917. This is divided 50 per cent, 25 per cent, 25 per cent for Federal aid, municipal and secondary roads, work being scheduled in all counties.

The state highway program includes 34 highway projects involving the construction of approximately 2.7 miles of concrete, 33.58 miles of bituminous macadam, 19.54 miles of gravel, and 14.33 miles of widening with bituminous macadam; also 8 bridge projects.

The municipal program includes 20 road projects and 2 bridge projects. The road projects provide for approximately 8.22 miles of concrete, 7.99 miles of bituminous macadam, and 1.57 miles of bituminous shoulder widening.

The secondary road program involves 102 highway projects and 5 bridge projects. The estimated mileage is 97.9 of gravel surface. These secondary projects are being built on a day labor basis.

New Hampshire—New Hampshire's allotment is $1,909,839 and is divided according to the percentages specified in the rules and regulations. On the Federal aid program they have 12 projects which they expect will build about 9.5 miles of concrete road, 3.5 miles of bituminous macadam, and 4.0 miles of gravel with mixed in place surface; also two overpass bridges over railroads and three river bridges, these five structures costing about $175,000.

There are 11 municipal projects which will build 5.5 miles of concrete and 4.5 miles of bituminous macadam.

The secondary system also has 11 projects which will build 25 miles of gravel, part of which will be surface treated and part will have mixed in place surface. There are also four bridges.

Vermont—Vermont's allotment of $1,867,573 is scheduled to construct 49 projects which will close 11 gaps in their Federal aid and state aid system, and will increase the surfaced mileages as follows: concrete 16 miles, macadam 10 miles, mixed in place 87 miles, gravel 9 miles; and three bridges. On one 7.5-mile project, the right-of-way of the Woodstock Railroad has been taken over and used for the new highway location.

Massachusetts—Massachusetts with an allotment of $6,597,100 has a program of 74 miles of road and 26 bridges and has requested under the 30/70 provision 74 miles of road and 8 bridges.

Connecticut—Connecticut has an allotment of $2,865,740. Its proposed program shows 18 projects totaling 64 miles of road improvement with surfaces of bituminous macadam, concrete, sheet asphalt; and in addition, 9.5 miles of landscaping work. One road construction project, 11 miles of macadam, is estimated at $440,000.

One important municipal project when completed will form a part of a bypass route around the City of New Haven and which will also allow traffic to and from the Yale Stadium without the necessity of traversing the city streets. This project is sheet asphalt on concrete base, width of roadway 48 ft., length of project 1.6 miles.

Rhode Island—Rhode Island's grant under the NIR Act was $1,998,708. The program submitted by the department, and approved in Washington, contemplates the improvement of 8 streets as extensions of the federal highway system in seven cities of the state, at an estimated cost of $580,000; 11 projects on the federal highway system outside of cities, estimated cost, $1,000,000; and 13 projects on secondary or feeder roads estimated cost, $408,000.

In all cases in the municipal projects, the reconstruction of existing worn-out pavements is involved.

Projects on the Federal Aid System outside of cities include the construction of a circumferential route around metropolitan Providence; part of a new trunk line route between New London, Conn., and Providence; together with the reconstruction of existing state highways with improved alignments and grades. The most important project under this latter classification is the reconstruction of a section of route U. S. 6, in which considerable relocation is involved.

Several landscape projects will be worked out similar to the picnic groves which they now have on some of their trunk line roads. In these groves 2-, 3-, and 4-way fireplaces are provided, with tables and benches for the accommodation of tourists.

New York—This state, with an apportionment under the NRA of $22,330,101, receives a greater amount for highway construction than any other state except Texas. Even a summary of the various highway, municipal, and secondary construction projects contemplated with this money is impossible in the limited time at our disposal.

Some very interesting work, however, is now under way on the broad parkways which extend from New York City over Long Island. These parkways include about 20 grade separations.

On Long Island also, is under construction a very unique project at Jones Beach Causeway, where two of five of the largest dredges in the world are at work filling in some 5,000,000 sq. yds. of material.

New Jersey—New Jersey's program of $6,346,039 is scheduled to improve 60 miles in 25 projects and includes 15 bridges and overpasses. One project 13.4 miles long includes bridge construction and costs $1,400,000; another, 11.6 miles long, costs $1,475,000, including bridge work. The outstanding project is the Newark Junction improvement where routes 21, 25 and 29 come together at Newark. Several lanes are already constructed and bids were received Sept. 18 for further work as part of the National Recovery program.

Delaware—Delaware has $1,814,088 and planned under this program the completion of their dual highway to Dover on Route U. S. 13, and the dual highway to the Maryland line near Elkton on U. S. 40; also the widening of a considerable mileage of main highways which were originally constructed some 12 or 15 years ago less than 20 ft. in width. They are also planning a bypass around the City of Wilmington to relieve congestion on U. S. 13 passing through the city. This last mentioned project will be particularly desirable to very heavy truck traffic which amounts to approximately 2,000 trucks per day, and will be a low grade avoiding two long 6 per cent grades on the present route.

Pennsylvania—Pennsylvania's allotment of $18,891,004 has been approved as follows: Municipal program, 28.67 per cent; Federal Aid System, 30.48 per cent; Secondary program, 40.85 per cent.

Bids are being received and work progressing rapidly in the completion of plans, specifications and estimates for the remainder of the program.

West Virginia—West Virginia's allottment was $4,474,234. Bids were received on Aug. 29, 30, and Sept. 19 representing approximately $1,300,000 of their program. The work includes approximately 25 miles of concrete pavement, 10 miles of surface treatment, 13 miles of grading and 13 bridges.

Maryland—While Maryland's allotment is $3,564,527, with the aid of other Government money and its own funds, the State Roads Commission has set up a highway construction program of 32 projects, costing $12,000,000.

The first two items on the program are as follows:

1. Philadelphia road, 29.8 miles, Baltimore and Hartford Counties. This appropriation is estimated to build a 56-ft. paved highway with a sidewalk on each side from the Baltimore city line to Golden Ring, and two 20-ft. paved highways separated by 6-ft. center parking and an 8-ft. gravel shoulder, and a sidewalk area on each roadway, to the Susquehana River at Havre de Grace. Estimated cost, $2,865,000.

2. Belair road, Baltimore and Hartford Counties, estimated to build a 40-ft. paved highway with a sidewalk on each side through the developed suburban area of Baltimore County and a 30-ft. highway with an 8-ft. dirt shoulder and sidewalk area on each side to Belair. Estimated cost, $1,062,000.

Second District, By B. M. Duncan, State Highway Engineer, Florida

This district has been allocated approximately $90,000,000 of the $400,000,000 National Recovery Funds

TABLE I—STATUS OF NATIONAL HIGHWAY RECOVERY PROGRAM ON OCTOBER 1, 1933, IN 12 SOUTHERN STATES

State	Nat'l Rec'y Allotment	Reg. Fed. Aid Balance	Total Fed. Fds. Available	Life of Program (months)	Contr's Awarded Amount	Contr's Awarded No.	Proj's Advt. Amount	Proj's Advt. No.	P. S. & E. Submitted Amount	P. S. & E. Submitted No.
Florida	$5,231,834	$989,000	$ 6,220,934	12	$1,256,741	12	$ 405,179	5	$ 671,149	8
North Carolina	9,522,293	977,000	10,499,293	15–18	1,200,000	30	0.00	0	1,200,000	12
Kentucky	7,517,359	48,000	7,565,359	18	950,000	11	1,100,000	20	2,300,000	45
Tennessee	8,492,619	576,000	9,068,619	..	641,000	7	900,000	14	1,000,000	..
Virginia	7,416,757	194,000	7,610,757	..	1,153,600	28	349,000	7	2,219,000	52
South Carolina	5,459,165	12,000	5,471,165	18	577,000	13	975,000	14	231,000	6
Georgia	10,091,185	100,000	10,191,185	14	0.00	0	0.00	0	2,000,000	..
Alabama	8,370,133	3,100,000	11,470,133	12	1,000,000	5	1,000,000	8	7,000,000	..
Mississippi	6,978,675	2,952,000	9,930,675	..	330,000	3	880,000	3	.....	..
Louisiana	5,828,591	0.00	5,828,591	15	810,000	8	233,000	2	1,000,000	9
Arkansas	6,747,335	663,000	7,410,335	16	330,000	4	234,000	1	0.00	..
Oklahoma	9,216,798	433,000	9,649,798	..	1,836,879	14	106,344	2	1,387,991	9
Total	$90,872,744	$10,044,000	$100,916,744		$10,085,220	135	$6,182,523	76	$19,009,140	143

PER CENT OF TOTAL FEDERAL FUNDS AVAILABLE

	Ala.	Ark.	Fla.	Ga.	Ky.	La.	Miss.	N. Car.	Okla.	S. Car.	Tenn.	Va.	Avg.
Contracts Awarded	9	4	20	0	12	14	3	11	19	10	7	16	10
Projects Advertised	9	3	7	0	15	4	9	0	1	18	10	5	6
P. S. & E. Submitted	61	0	11	19	30	18	0	11	14	4	11	32	19
	79	7	38	19	57	36	12	22	34	32	28	53	35 = Approx. $35,000,000.00

TABLE II—NRA FUNDS ALLOTTED AND THEIR DISTRIBUTION BETWEEN "H," "M," AND "S" PROJECTS

State	Total Amount	—Highway Projects— Per Cent	Amount	Municipal Projects Per Cent	Amount	Secondary Road Projects Per Cent	Amount
Illinois	$ 17,570,770	25.22	$ 4,431,348	39.14	$ 6,877,200	35.64	$ 6,262,222
Ohio	15,484,592	45.0	6,968,066	30.0	4,645,378	25.0	3,871,148
Michigan	12,736,227	40.0	5,094,491	35.0	4,457,679	25.0	3,184,057
Missouri	12,180,306	50.0	6,090.153	25.0	3,045,077	25.0	3,045.077
Indiana	10,037.843	47.0	4,717,786	48.0	4,818,165	5.0	501,892
Wisconsin	9,724.881	50.0	4,862,441	25.0	2,431,220	25.0	2,431.220
Minnesota	10,656.569	48.0	5,115.153	32.0	3,410,102	20 0	2,131.314
Iowa	10.055.660	50 0	5,237.000	25.0	2.525.000	25.0	2.578.000
Kansas	10,089.604	50.0	5,044,802	25.0	2,522,401	25.0	2,522.401
Nebraska	7,828,961	50.0	3,914,481	25.0	1,957.240	25.0	1,957.240
South Dakota	6,011.479	50.0	3,005.739	25.0	1,502.870	25.0	1,502 870
North Dakota	5,804,448	50.0	2,902,224	25.0	1,451,112	25.0	1,451,112
Total	$128,181,340	44.0	$57,383,684	31.0	$39,643,444	25.0	$31,638,553

TABLE III—NRA WORK UNDER CONTRACT—OCT. 1, 1933 (Percentages based on amounts)

State.	Total Amount	"H" Projects Amount	"M" Projects Amount	"S" Projects Amount	Estimated Cost Index*
Illinois	$ 1,005,047	$ 336,782	$ 330,105	$ 338,160	123
Ohio	5,857,442	4,727,430	1,130,012	None	140
Michigan	1,224,000	1,200,000	24,000	None	115–2
Missouri	2,732,073	2,557,464	174,609	.....	125
Indiana	1,750,000	1,750,000	.....	.....	...
Wisconsin	2,143,000	1,492,000	437,000	214,000	100
Minnesota	2,199,000	1,421,000	663,000	115,000	110
Iowa	3,309,600	2,486,000	347,200	476,400	120
Kansas	1,769,000	1,500,000	203,000	66,000	125
Nebraska	3,300,000	2,700,000	200,000	400,000	...
S. Dakota	1,800,000	1,500,000	150,000	150,000	115–2
N. Dakota	750,000	750,000	.....	.....	125
Total	$27,839,162	$22,420,676	$3,658,926	$1,759,560	
Per Cent	22% of Total	40% of Total "H" Allotments	9% of Total "M" Allotments	6% of Total "S" Allotments	

*NRA contracts—1932 prices.

for road purposes. The activities of the various states in the Second District are summarized in Table I.

It appears from this tabulation that these states have made a satisfactory start to carry on a conservative, orderly highway construction program with this appropriation. The states have estimated the time required to complete this program as from 12 to 18 months. It is my understanding that these funds are available until expended. Should the occasion arise or the nature of the emergency demand, it is believed that much more progress could be made than that now anticipated by the states.

It must be borne in mind that all of these states, due to favorable climatic conditions, can do satisfactory construction work from 10 to 12 months each year.

The rules and regulations as promulgated for this program, have made it possible for the highway departments to complete the long delayed, expensive and troublesome gaps in the primary and secondary highway systems. For the first time, federal funds are available to construct the main highways through the smaller towns and cities, of the proper width, types, and refinements to relieve congested areas on the main highway system. The expenditure of these funds in municipalities will have a moral effect on our city governments, which will, no doubt, be helpful during the coming sessions of the legislatures, when the cities continue their demands for a part of the gasoline funds. These municipal projects will also give employment in the centers of population where relief is most needed.

It has allowed the states to take such funds as they have available and continue maintenance on the entire system. Most states have included in their program a number of betterment and beautification projects, which will reduce the maintenance cost and further protect our major highway investment.

For the first time the rules and regulations require that consideration be given to feeder roads, for railroad and other transportation systems. It is believed that this

TABLE IV—PROPOSED HIGHWAY CONSTRUCTION BY TYPES—(MILES OF TWO-LANE CONSTRUCTION OR EQUIVALENT) GRAND TOTAL, 4,975 MILES

State	Concrete Pavement or Equivalent Miles	Concrete Pavement or Equivalent Amount	High Type Bituminous Miles	High Type Bituminous Amount	Medium Type Bituminous Miles	Medium Type Bituminous Amount	Low Type Bituminous Miles	Low Type Bituminous Amount	Untreated Gravel or Equivalent Miles	Untreated Gravel or Equivalent Amount	Grading Only Miles	Grading Only Amount
Illinois	44.3	$ 1,640,400	....	.....	....	.....	.....	.....	.....	.....	.....	.....
Ohio	100.00	4,277,458	40.0	$875,900	15.0	$229,888	.....	.....	20.0	$ 388,142	In conn. with Surf.	
Michigan	106.6	2,558,000	....	.....	10.3	135,000	33.3	$ 173,000	136.5	810,000	89.7	$ 660,000
Missouri	127.0	3,765,000	....	.....	....	.....	16.0	40,000	8.5	19,000	24.7	352,000
Indiana	159.8	3,785,000	....	.....	....	.....	.....	.....	29.0	215,000	6.4	125,000
Wisconsin	112.5	3,023,000	....	.....	37.6	360,000	108.3	531,000	13.0	255,000	25.6	165,080 (Misc. 3,000)
Minnesota	23.	574,000	....	.....	....	.....	777.	2,610,000	None shown		146.0	926,000
Iowa	136.5	3,047,000	....	.....	....	.....	135.8	351,000	32.8	48,000	153.2	1,311,000
Kansas	83.0	1,573,200	....	.....	(none reported)		124.0	221,320	82.9	104,230	455.6	3,055,000
Nebraska	.....	.....	.....	None	.....	.....	Shown	.....	.....	.....	.....	.....
South Dakota	25.0	600,000	....	.....	....	.....	.....	.....	174.	350,000	120.	500,000
North Dakota	...	.....	....	.....	....	.....	100.0	470,000	542.	650,000	600.	1,800,000
Total	917.7	$24,843,058	40.0	$875,900	62.9	$724,888	1,294.4	$4,396,320	1,038.7	$2,839,372	1,621.2	$8,897,080
Average per mile		27,200		21,900		11,500		3,400		2,800		5,500
Per cent of Grand totals (57,289,123)		43%		1.5%		1.3%		8%		5%		15%

TABLE V—PROPOSED SECONDARY ROAD CONSTRUCTION BY TYPES (MILES OF TWO-LANE CONSTRUCTION OR EQUVALENT) GRAND TOTAL, $31,638,558

State	Concrete Pavement or Equivalent Miles	Concrete Pavement or Equivalent Amount	High Type Bituminous Miles	High Type Bituminous Amount	Medium Type Bituminous Miles	Medium Type Bituminous Amount	Low Type Bituminous Miles	Low Type Bituminous Amount	Untreated Gravel or Equivalent Miles	Untreated Gravel or Equivalent Amount	Grading Only Miles	Grading Only Amount
Illinois	30.4 (or Br.)	$ 784,320	....	.....	6.3	$ 58,700	31.4	$ 203,000	254.25	$1,381,500	.....	.....
Ohio	30.0	985,901	30	$671,616	20.0	315,847	.....	.....	35.	562,748	.....	.....
Michigan	28.4	794,000	1.0	30,000	15.2	128,000	98.4	702,000	93.4	397,000	512	$ 414,000
Missouri	3.4	110,000	....	.....	....	.....	.....	.....	88	220,000	316	1,250,000
Indiana	.....	.....	.....	.....	In Preparation		.....	.....	.....	.....	.....	.....
Wisconsin	49.1	1,215,500	....	.....	....	.....	142.7	675,000	62.6	675,000	.....	.....
Minnesota	9.	240,000	....	.....	....	.....	95.	185,000	....	.....	150	1,073,000
Iowa	13.6	350,000	....	.....	....	.....	46.8	119,500	24.4	49,000	246.6	1,942,500
Kansas	7.24	175,000	None at this date		.....	.....	.....	.....	40.45	59,050	311.9	1,807,015
Nebraska	.....	.....	.....	None	Shown		.....	.....	.....	.....	.....	.....
South Dakota	.....	.....	....	.....	....	.....	.....	.....	4.0	30,000	50.	120,000
North Dakota	.....	.....	....	.....	....	.....	.....	.....	335.	335,000	372.	1,116,000
Total	171.1	$4,654,721	31.0	$701,616	41.5	$502,547	414.4	$1,884,500	937.1	$3,709,298	1,497.7	$7,722,515
Average per mile		27,200		22,600		12,100		4,550		4,000		7,750
Per cent of grand total		15%		2%		1.5%		6%		12%		24%

action will create a better feeling and have a tendency to harmonize the entire network of our transportation whether highway, rail, air, or water.

Third District, By T. J. Pattison, State Highway Department, Wisconsin

The 12 states which compose the third district include about 25 per cent of the area of the entire country and 33 per cent of the population. The allotment to these states is 39 per cent of the total $400,000,000. The total mileage of rural highways in the district is 40 per cent of the total in the United States. The mileage of Federal aid highways is 6.7 per cent of the total highway mileage, slightly less than the 7 per cent permitted by the Federal aid law. The distribution of the allotment to the Highway, Municipal and Secondary projects is shown in Table II. Taken as a whole the distribution follows very closely the distribution suggested by the Act, being 44 per cent for Highway projects, 31 per cent for municipal projects, and 25 per cent for Secondary projects. The estimated condition with respect to the letting of contracts, as of Oct. 1, is shown in Table III. It appears that contracts have been let for approximately 22 per cent of the total program and that about 80 per cent of the total lettings have been on Highway projects, of which 40 per cent of the total has been contracted. Contracts on Municipal projects represent only 9 per cent of the total amount set aside for Municipal projects, and the same figure for Secondary projects is only 6 per cent of the total.

No subject in connection with the development of a state trunk highway program is of greater interest than the character of improvements projected. This is shown for Highway projects in Table IV. The character of improvements set up on secondary roads is substantially the same as for the primary roads, as is shown by Table V. Statistics with reference to Municipal projects and roadside improvement projects are shown in Table VI. These projects do not lend themselves so readily to classification, because they can not possibly be uniform or comparable. It will be noted that the estimated average price of new pavement is $2.84 per square yard and the estimated average cost of resurfacing is $2.01 per square yard.

The extent to which the NRA funds will be applied to the building of railroad grade separation structures is shown in Table VII. The railroad grade crossing elimination work to be carried out under the program reaches the imposing total of 197 separations—nearly 17 per state.

TABLE VI—PAVING ON MUNICIPAL PROJECTS—ROADSIDE IMPROVEMENT PROJECTS

State	Pavement Sq. Yd.	Pavement Amount	Resurfacing Sq. Yd.	Resurfacing Amount	Roadside Improvement Miles	Roadside Improvement Amount	Avg. Per Mile
Illinois	1,539,785	$ 4,537,500	119,633	$ 263,200	136.3	$382,000	$ 2,800
Ohio	645,400	2,607,454	224,100	528,350	5.0	40,000	8,000
Michigan	Not Avail.	1,776,000	Not Avail.	1,902,000	4.0	72,170	18,000
Missouri	234,000	603,000	.....	.....	None Shown		
Indiana			In Preparation		7.0	3,000	
Wisconsin	980,000	2,460,860		.....	32.8	51,000	1,550
Minnesota	275,000	600,000	250,000	700,000	20.0	100,000	5,000
Iowa	411,600	1,484,000	(See Sheet)		None Shown		
Kansas	750,000	1,500,000	400,000	500,000	25.0	25,000	1,000
Nebraska			None Shown			None Shown	
South Dakota	70,000	140,000					
North Dakota	Not Shown	1,250,000	Not Shown	200,000		Not Decided	
Total	4,905,785	$16,958,814	993,733	$4,003,550	230.1	$673,170	$ 2,900
Average per square yard	$2.84		$2.01				

TABLE VII—RAILROAD GRADE SEPARATION STRUCTURES

State	Total No.	Total Cost	Highway Projects No.	Highway Projects Cost	Municipal Projects No.	Municipal Projects Cost	Secondary Road Projects No.	Secondary Road Projects Cost
Illinois	73	$ 5,060,500	32	$2,152,500	No.	Cost	No.	Cost
Ohio	8	1,079,000	4	409,000	28	$2,071,000	13	$ 837,000
Michigan	4	98,000	2	40,000	4	370,000	2	300,000
Missouri	26	843,000	14	368,000	2	58,000	..	.....
Indiana	11	565,000	11	565,000	10	435,000	2	40,000
Wisconsin	4	390,000	2	200,000	..	.....	..	.....
Minnesota	26	538,000	16	283,000	1	100,000	1	20,000
Iowa	32	1,076,000	16	394,000	9	230,000	1	25,000
Kansas	8	235,000	4	100,000	14	640,000	2	42,000
Nebraska		None Shown			3	100,000	1	35,000
South Dakota	...	.....	...	.....	..	.....	..	.....
North Dakota	5	141,000	3	68,000	2	73,000	None	
Total	197	$10,025,500	104	$4,579,500	73	$4,077,000	22	$1,369,000

TABLE VIII—MAJOR STRUCTURES OTHER THAN RAILROAD GRADE SEPARATION STRUCTURES

State	Total No.	Total Cost	Highway Projects No.	Highway Projects Cost	Other Structures Municipal Projects No.	Other Structures Municipal Projects Cost	Other Structures Secondary Projects No.	Other Structures Secondary Projects Cost
Illinois	11	$1,202,500	5	$ 612,500	No.	Cost	No.	Cost
Ohio	141	2,890,216	62	902,533	3	$ 240,000	3	$ 350,000
Michigan	86	2,048,057	30	699,000	22	902,000	57	1,085,683
Missouri	9	550,000	4	390,000	26	630,000	30	719,057
Indiana	1	25,000	1	25,000	5	160,000	...	.....
Wisconsin	10	565,000	5	215,000	None		None	
Minnesota	20	1,071,000	2	53,000	2	215,000	3	135,000
Iowa	9	422,000	2	86,000	14	800,000	4	218,000
Kansas	14	700,000	8	400,000	5	261,000	2	75,000
Nebraska		None Shown			1	100,000	5	200,000
South Dakota	2	50,000	2	50,000				
North Dakota	5	45,000	4	37,000	1	8,000	None	
Total	308	$9,568,773	125	$3,470,033	79	$3,316,000	104	$2,782,740

The number of other major structures is 308, representing a total expenditure of $9,568,773. As would naturally be expected, the states have taken advantage of the NRA program to replace many unsafe and obsolete structures. Figures with reference to this type of construction are shown in Table VIII.

Fourth District, By R. H. Baldock, State Highway Engineer, Oregon

To the 12 Western states and the Territory of Hawaii, the Federal Government has allotted for highway work under the NRA the sum of $97,000,000, the amounts allotted to the different states varying from $24,200,000 for Texas, our largest state, to $1,900,000 for Hawaii.

The work to be accomplished with the money will comprise all of the usual classes of highway construction such as grading, surfacing, oiling, bituminous macadam, paving and bridge construction. It will include both new construction and reconstruction work.

In every state there are many miles of highways built in the early days of the present era of road building which are no longer adequate for the traffic which they carry; highways which at one time were the finest examples of the road builder's art, but which are now obsolete and inadequate. The NRA funds provide the means of modernizing such highways and of eliminating the heavy maintenance expense which they entail. A very large proportion of the allotments of those funds to Western States will be invested in work of this nature.

Another class of highway that has become an almost unbearable burden on state highway maintenance funds is the untreated crushed rock or gravel surfaced highway. Such a road, besides being expensive to maintain under even very light traffic conditions, is so unsatisfactory from a service standpoint that every engineer looks forward to the day when it will be a thing of the past. Oil treatments paid for with NRA funds will eliminate a very large proportion of the remaining mileage of that class of highway. Bituminous macadams and the higher types of pavements built with NRA funds will also replace many miles of heavily traveled oil-treated surfacing, thereby effecting a further reduction in maintenance costs.

Another use to which NRA funds can very advantageously be put is the replacement of narrow bridge structures. Sixteen-, 18- and 20-ft. bridges have long been inadequate and unsafe. Nevertheless nearly every state has a few such bridges in use on its main highways. Funds for their replacement have not been available. It will indeed be a relief to see these inadequate structures replaced with fine new structures made possible by the National Recovery Act.

The elimination of grade crossings is a matter which is receiving considerable attention in the programs of the Western states. Each state will utilize a part of its NRA funds in the elimination of these danger points, but due to insufficiency of funds and the great need for improvements of other kinds, not as much will be done in that line as could be desired.

During the past few years there has been evidenced a growing tendency toward higher standards of construction, and this tendency will be reflected in the National Recovery projects.

The construction of highways into and through cities is a new departure in most of the Western states, and many of the highway departments were at first rather dismayed by the requirement of the National Recovery Regulations which makes it mandatory to use one-fourth of the available funds in municipalities. This feeling is rapidly changing, however, and the departments are finding that this requirement is going to make it possible for them to overcome a condition of which they have complained for years; namely, the unsatisfactory entrances to many of the cities. In many cities there has long been a sort of "No Man's Land" between the thickly built-up portion of the city and the corporate limit line, and the problem of providing for main highway traffic across that area has been long neglected. The highway departments now have funds with which to better this unsatisfactory condition.

TABLE IX—SUMMARY OF ALLOCATION OF NATIONAL RECOVERY FUNDS—TWELVE WESTERN STATES AND HAWAII

State	Total Allotment	Distribution of Funds — N. R. H. Per Cent	N. R. H. Amount	N. R. S. Per Cent	N. R. S. Amount	N. R. M. Per Cent	N. R. M. Amount
Montana*	$ 7,439,748		$ 3,703,000		$ 1,723,000		$ 814,000
Wyoming	4,501,327	50	2,250,663	25	1,125,332	25	1,125,332
Colorado	6,874,530	50	3,437,265	25	1,718,632	25	1,718,633
Texas	24,244,024	50	12,122,012	25	6,061,006	25	6,061,006
Idaho	4,486,249	50	2,243,125	25	1,121,562	25	1,121,562
Utah	4,194,708	50	2,097,354	25	1,048,677	25	1,048,677
New Mexico	5,792,935	73	4,257,505	12	654,430	15	881,000
Arizona	5,211,960	73	3,811,260	12	600,700	15	800,000
Nevada	4,545,917	64	2,909,387	25	1,136,479	11	500,051
Washington	6,115,867	50	3,057,933	18	1,085,000	32	1,972,934
Oregon	6,106,896	50	3,053,448	25	1,526,724	25	1,526,724
California	15,607,354	50	7,803,677	25	3,901,838	25	3,901,839
Hawaii	1,871,062	50	935,531	25	467,776	25	467,765
	$96,992,577		$51,682,160		$22,171,146		$21,939,523

*Montana has programmed only about 85 per cent of total allotment, expecting increases in bid prices and other projects to be added.

TABLE X—TYPES OF CONSTRUCTION FOR STATE HIGHWAY, MUNICIPAL AND SECONDARY PROJECTS FOR 12 WESTERN STATES

	Grading and Rock Surfacing, Miles	Oiling and Paving, Miles	Structures — Number	Structures — Amount
Montana	613	154	146	$ 1,124,000
Wyoming	416	400	3	114.000
Colorado	386	73	23	1,593,000
Texas	2,070	362	103	5,101.000
Idaho	249	214	31	892,000
Utah	81	227	17	364,000
New Mexico	100[1]	504[1]	4[4]	256.000
Arizona	140	313	7	240,000
Nevada	295	223	5	114,000
Washington	144	75	14	366,000
Oregon	188	278	59	204,000
California	45[2]	320[3]	77	1,898,000
Total	4,735	3,165	486	$13,359,081

[1]Mileage for state highways only, not reported for municipal and secondary roads. [2]Mileage for state highways only, mileage for secondary roads not reported but estimated cost given as $637,000. [3]Mileage for state highways only; mileage for municipal highways and secondary reports not reported but estimated costs given as $3,000,000 and $2,652,838 respectively. [4]Bridges on state highways only; estimated cost of bridges on municipal highways, $495,000.

EDITORIALS

"Pegging the Dollar"

IN the April issue of ROADS AND STREETS it was shown that for 90 years average wages in America have been proportional to per capita currency, and reference was there given to data that prove that wages are also proportional to velocity of circulation of currency. These two are the only factors that determine average wages —or at least they have been the only factors of any consequence as far back as reliable data are available.

It follows that it is very improbable that the mere buying of gold by the government will have an appreciable effect upon wages, for such purchases neither increase the stock of money appreciably nor cause an increase in its rate of circulation. Already the purchase of newly mined gold at increasingly higher prices has failed to increase commodity prices, so it is now planned to buy gold in the world market. This will probably prove equally ineffective, for it involves no increase in our stock of money, and leads to no speeding up of its circulation.

The president has declared that he will resort to other expedients if these fail to increase prices. Of the expedients that may accomplish his purpose there is only one that will act quickly, and that is the printing of money accompanied by paying it out for goods and service. But this is an expedient that he is evidently averse to trying.

The president has said that he will not "stabilize (peg) the dollar" until he has restored average prices and wages to about the level that preceded the depression. And he has said also that thereafter average prices will be maintained at about a constant level. Since the velocity of circulation is constantly changing even in normal times, there is no way of holding average prices constant except by constant changes in the total volume of currency.

Merely changing the number of grains in a dollar will not change the number of dollars. Hence he will be confronted by the problem of constantly changing the number of dollars in circulation, once average prices have reached the desired level. This will mean that for a while dollars will have to be paid out by the government, and then for a while dollars will have to be called in.

Suppose the present number of dollars were to be increased by 50 per cent, and used to buy goods and services. Since the present velocity of circulation is about two-thirds of normal, a 50 per cent increase in currency would offset the decreased velocity of circulation, and restore the price and wage levels of 1929—provided that the velocity of circulation remains what it now is. But a rapid issuance of currency would probably cause the velocity of circulation to increase, and if none of the 50 per cent increase in currency were retired, we would eventually find ourselves with a price level 50 per cent higher than in 1929.

Consideration of such matters indicates that it is impossible to "peg the dollar" in terms of gold, and at the same time maintain a constant price level. The "pegging" that seems desirable today will be found wrong tomorrow, and so on to the end of time.

But it does not follow that approximate stability of prices is unattainable. We are merely pointing out that a "pegged dollar" is one way in which that desirable goal can not be reached.

If we are right, and if the president persists in experimenting until he finds a way of stabilizing average prices, he will probably adopt a paper dollar whose numbers in circulation will be increased when prices fall, and decreased when they will rise above the standard price level. Gold will then cease to bear any legal relation to the dollar, and will become only a medium of international exchange. Having reached that status its value will drop rapidly, and it may ultimately cease to be used even as an international medium.

The great danger that will attend the "commodity dollar" will be that a government burdened with debt may readily repudiate any part of that debt—or all of it—by printing a suitable number of dollars. Our government has already repudiated its promise to pay holders of its bonds in gold. Will it balk at other repudiations? It has passed a law that has caused municipalities and corporations to repudiate their promises to redeem their bonds in gold. So investors are asking whether there is such a thing in America as a contract that is inviolable as regards the kind of money involved. Contracts to pay in gold have been repudiated. Contracts to pay in dollars based on a commodity price index can be just as easily repudiated.

Bouncing the Rubber Dollar on the Farmer's Head

IT has often been proposed that the number of grains of gold in a dollar be regulated by government at frequent intervals, with a view to maintaining a nearly constant average of commodity prices. For the first time in our history congress has authorized a president to do that very thing. He hasn't done it yet, but he has declared his intention of restoring the commodity price level that preceded the depression. Up to the present his efforts have been directed toward bringing the velocity of circulation of money back to normal. A general rise in commodity prices has occurred, but most farmers complain that they have been injured by the rise, because it has been less rapid for the things they sell than for the things they buy.

We fail to see how any method that increases average prices quickly can be so operated as not to injure some classes of employers and their employes. Currency inflation will increase average prices if it does not frighten many capitalists into refraining from using their currency and credit. But increasing average prices must temporarily intensify the disparity between the buying power of different classes of workers, for there is no practical way of raising all prices on equal percentage simultaneously.

It is claimed that a "compensated dollar" can be devised that will maintain an average price level; for when average prices decline, say one per cent, the number of grains in a gold dollar can be decreased one per cent and thus raise the average prices back to the standard level. Even if price manipulation should turn out to be as simple as that, only average prices would be prevented from declining or rising. Individual prices could and would fall or rise. Naturally bitter complaints come from the producers of goods that were declining while other goods were rising in price as a result of government manipulation of the number of grains in the dollar. Politicians reply that such complaints exist now even before the government has applied the rubber-dollar theory. Yes, but when the rubber-dollar becomes a fact, and is bouncing off the heads of the embattled farmers, who expects them to become less embattled?

W. P. Gillette

County and Township Roads

A Section Devoted to the Interests of Those Responsible for Secondary Road Improvement

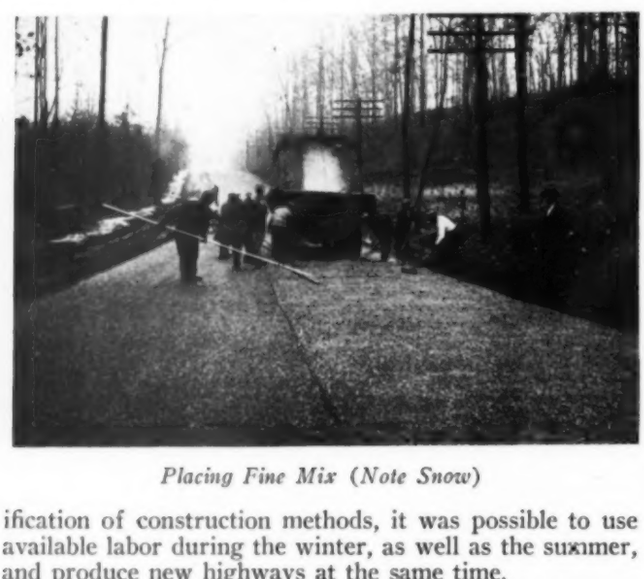
Efficient Unemployment Relief in Union County, New Jersey

By GEO. E. MARTIN

Consulting Engineer, General Tarvia Department, The Barrett Co.

UNEMPLOYMENT relief has been a pressing problem in most communities during the past year. Union County, New Jersey, has reached one solution whereby relief work has been furnished and the public has received benefits for the money expended.

The use of unemployed labor to build highways is not a new or original idea. However, the greatest need for unemployment relief is during the winter months, when ordinary road building usually takes a holiday. By proper selection of the materials to be used and a modification of construction methods, it was possible to use available labor during the winter, as well as the summer, and produce new highways at the same time.



Placing Fine Mix (Note Snow)

Glenside Avenue, leading from Summit, N. J., through the Watching Reservation, was selected as one road to be improved. Before the work was started, Glenside Avenue was a narrow, crooked road with steep grades. Some surfacing material had been placed on it so that it was passable, but could not be considered a very satisfactory highway.

Subgrading.—It was decided to widen the road to a paved width of 20 ft. The grading was done by unemployed labor working in gangs. While all the work possible was done by hand, machinery was utilized where it was considered necessary to use it. Drainage structures were installed where needed. The side slopes of the road were cleared, trimmed up and shaped at the same time. The subgrade was now ready for the macadam foundation.

The Base.—A 6 in. macadam base was built according to standard methods. Stone was purchased from local quarries and hauled to the job in county trucks. It was spread over the subgrade to the required depth from the dump trucks. Final spreading was accomplished by a gang of unemployed labor. One or more experienced road builders, recruited from the regular county road building forces, were included in each gang to instruct and assist the inexperienced men.

The loose stone was then thoroughly rolled and filled with stone screenings.

Because of the necessity for working under winter weather conditions, it was not deemed advisable to use water and build the ordinary water bound macadam foundation. In place of the water, a cold refined tar was used. This material had a specific viscosity at 40° C. of 8 to 13 and was purchased from The Barrett Company, being their material "Tarvia B." This cold tar was applied by means of a pressure distributor at the rate of ½ to ¾ gal. per square yard. It penetrated into the macadam surface to the depth of an inch or more and thoroughly bound the particles of stone together. It also waterproofed the top of the foundation.

The Wearing Surface.—The selection of the wearing surface was the next problem. The material must be one which would be available at all times and one which could be handled throughout a normal New Jersey winter. This meant that some work might have to be done soon after snow storms with the temperature at freezing or below.

The decision was made to use a tar coated, pre-mixed stone called "Tarvia-lithic," produced at a central mixing plant at Bound Brook, N. J.

The wearing course was placed in two layers, first a 2 in. layer of intermediate size Tarvia-lithic made of

Rolling Fine Mix

Heating Tools

The Finished Job

stone averaging about 1 in. in diameter. The material was hauled about 20 miles in county dump trucks. Canvas covers were used on the trucks to retain the heat in the mixture. Shovels, rakes and other tools were heated in a portable heater.

In some instances it was necessary to use surface heaters to dry the surface before the wearing course was laid. At one or more times the wearing course was laid after snow had been shoveled from the top of the foundation.

The intermediate layer was thoroughly rolled before the top course was added. This top course was made up of tar coated chips and was spread over the intermediates to the depth of about an inch. Great care was taken to level off the surface so as to obtain an easy riding road. This work was done by unemployed labor with satisfactory results. Some of the men were not accustomed to manual labor and were slow at the start but soon toughened and were able to keep up with the gang. Keeping a certain number of experienced county men with each gang set the pace and produced excellent results for this class of unskilled labor.

The top layer of Tarvia-lithic fines approximately 1 in. thick was rolled to a solid, even surface and the road was then thrown open to traffic.

The road has been built in sections as funds have become available and is now several miles long. The county paid for the material and the state paid for the labor from unemployment relief funds.

By working in this manner, Union County was able to give direct employment to many men and obtain a new highway to show for the money expended.

This work was done under the general direction of Herman Kling, County Supervisor of Roads, Union County, New Jersey.

Laboratory Traffic Test for Low-Cost Road Types

A small circular test track for applying, in the laboratory, traffic tests to sections of highway surfaces has been built and placed in operation by the U. S. Bureau of Public Roads at the Arlington Experiment Farm. The test was designed primarily for the study of low-cost bituminous types, but it is believed that it may be adapted for other studies, such as, motor vehicle tire wear, subgrade stabilization, etc.

The apparatus consists of an annular concrete trough 12 in. deep, 18 in. wide, and 12 ft. in diameter at the center line. The depth is sufficient to permit the use of various combinations of base materials beneath the bituminous test surfaces. Along the smaller circumference of the trough in which the test sections are held, and cast integrally with it, is another trough 3 in. wide and 13 in. deep intended to be used as a reservoir for the introduction of water into the base material under the test surfaces through small openings at the base of the partition wall. By this arrangement the track may be flooded or water may be introduced through capillarity.

Two full-size automobile wheels provide the traffic for the tests. These wheels are fixed to the two ends of a rigid structural member which is rotated in a horizontal plane by a vertical shaft in the pedestal at the center of the track. The upper end of this shaft is squared and on it rides a freely sliding square nut mounted in trunnions in the cross member. This arrangement causes a constant wheel load (that due to the weight of the wheels, tires, and cross member) to be applied at all times regardless of the irregularities of the test surfaces. At present this load amounts to about 800 lb. per tire. Although the distance between the two test wheels is fixed, a handwheel adjustment is provided which shifts the position of the square nut with respect to the midpoint of the cross member and enables the operator to place the path of either wheel at any point on the test surface.

An electric motor operating through a 3-step cone pulley and a worm reduction drives the vertical shaft at the center of the track.

The test wheels may be operated at speeds at 4½, 6, or 9 miles per hour as desired. The low speed has proved to be the most convenient when distributed traffic for compacting the surface is required. For the testing of the completed surfaces, concentrated traffic and the highest speed are used.

The number of trips made by each wheel is recorded by an electrical contact mechanism on the central vertical shaft operating a magnetic revolution counter at a point outside the track. In addition to this record, the data being collected include the corresponding behavior of the material under test, the density of the surface before and after test, oil migration, water content, and amount of material lost due to raveling. It is hoped that this information will make possible the evaluation of the important factors affecting the behavior of oiled aggregate mixtures.

The apparatus is now being used to investigate the effect of the percentage and consistency of the bituminous material on the durability and stability of mixtures with one type and grading of aggregate. A later phase of this first series of tests will involve a study of the effect of capillary water on the same mixtures. Various other factors influencing the behavior of different types of bituminous surface will be studied.

Operations of County Bridge Crew in Indiana

By J. R. Gregory

County Surveyor, Warren County, Indiana.

BEFORE 1930 all of Warren County's bridge and culvert repair work was done by contract. Dissatisfaction over some of the bids for repairs during that year caused the board of commissioners to organize a county bridge repair department with the county engineer in charge. Some equipment was bought, men were hired, and work was started about the middle of the year.

This department was to make all bridge and culvert repairs that would not exceed $500 in cost. The character of the work included the reflooring and painting of some of our longer steel bridges, the widening of the older stone and concrete culverts and bridges to a standard width of 24-ft. clear roadway, the replacing of bridge floors, wings, and abutments, the constructing of some of the large concrete headwalls of the cantilever type, and the building of temporary bridges in cases of emergency. For the year 1930, repairs were made in this manner to the amount of $9,400.

In 1931, the first year the writer had charge of this department, 20 repairs were made at a total cost of $5,478, or an average of $274 per job. In 1932, a total of 19 repairs were made, costing $4,910, or an average of $258 per job. These figures include all costs of labor, materials, repairs, and supplies of every kind except costs of gasoline and oil and depreciation of equipment.

Repair Crew and Equipment—The present personnel of the repair crew consists of a working foreman and from three to five workmen, one of whom is also the truck driver. These men are picked with an idea as to what will be required of them. One is a carpenter, another a truck driver, another excels in the homely art of being an excellent dirt handler. All workmen on the bridge crew are employed directly by the engineer.

The equipment consists of a 1½-ton truck, a half-sack-batch concrete mixer, a 3-in. diaphragm power pump, a tank wagon and tanks, a sectional tool and cement shed, and all the tools necessary for this class of work.

The highway superintendent, a member of the board of commissioners, or the engineer, reports to the board of commissioners the need of any repair. The board, if it is favorable and if the estimated cost of the proposed repair is over $200 and under $500, orders plans to be drawn by the engineer and submitted for their approval. Upon approval, the engineer is ordered to proceed with the work. Repairs estimated to cost less than $200 are made directly by order from the highway superintendent or by informal consent of the board of commissioners.

It must be understood that to keep within a limit of $500 no single job can be very extensive. So it has always been our plan to make as many repairs in one locality as possible. Thus we cut down the cost of moving, and if jobs are less than a mile apart, we work on both at the same time. The work is first laid out by the engineer, who sets all line and grade stakes and supplies the foreman with the necessary plans. The work, in the absence of the engineer, is in charge of a working foreman who is supposed to do a reasonable day's work besides overseeing the job. He has charge of from three to five men, according to the size of the job and the time to complete it. A daily report is made out by the foreman and given to the engineer at the end of each day's work. This report is a form blank with spaces for names and classes of work outlined. The foreman notes the number of hours each man works and on what particular part of the work. The foreman also notes on this report the amount of work, in detail, completed that day. In this manner, it is easy to compare costs, and if any particular part of the work is running too high, to investigate. Daily contact is made with the work, either by the foreman's reporting at the end of the day or by the engineer's making personal inspection.

Selection of a competent foreman is essential, if a county bridge repair department is to be successful. He must not only be able to handle the men and the work to best advantage, but also be able to read blue prints and be far-sighted enough to plan his work for more than one day at a time.

Typical Examples—The engineer has considerable responsibility, also. Decision, good engineering, and good judgment are necessary. A bridge or culvert that four years ago might have been condemned with a wave of the hand is now being examined carefully to see if it can not be made to last another year or, with a reasonable amount of expense, be restored to first-class condition. In 1931 we had a case that will illustrate my point. A culvert on one of the township roads was partly washed out and the township trustee petitioned the board of commissioners to make the repair. The board turned the job over to the bridge repair department. The culvert was 10 ft. in span, about 7 ft. high, and had a roadway 15 ft. wide in the clear. The abutments were 6-in. vertical I-beams filled in between with concrete. The I-beam floor stringers, carrying a concrete floor, were rivited to the vertical I-beams in the abutments. One abutment had settled so much out of line that the concrete had cracked and loosened. The other abutment, if it could be called that, had only about a 10-in. footing.

When we dug out our footings for the extension of this abutment, we cut in under from each end of the old abutment to a distance of about 4 ft. and ran a new footing under the old part. A few days later, after this footing could carry the weight, we dug out in front of the middle part of the old abutment and ran in the balance of the new footing. Of course, we braced the wall and supported the floor while this and the building of the complete new abutment was being done. Not an extraordinary piece of work, but it saved a fairly good percentage of cost of the entire work and it will last indefinitely. And aside from a part of the floor being somewhat more rough than the outside edges, the traveler does not know that the entire culvert is not in first-class condition.

The gravel used on repair work is a "concrete mix" washed gravel from commercial pits. The gravel content grades from 1¼-in. down to ¼-in. in size. The sand content runs from 45 per cent to 50 per cent of the total volume. We find that a high percentage of builder's sand in the total sand content faces better and more easily. At rare intervals we can find gravel in a pit or stream bed that is well graded and clean enough to be

used in concrete work. Great care is taken, however, in selecting such material. Quality of materials are never sacrificed for a slight decrease in cost.

The mix, using a "concrete mix" gravel for aggregate, range from 5 sacks of cement to the cubic yard for heavier portions of the work, to 6 sacks of cement to the cubic yard for the smaller sections. During 1932 we paid foremen 60 cts. per hour, carpenters 35 cts. per hour, and all other labor 30 cts. per hour. The cement was contracted by the year for $1.85 per barrel from stock. Gravel cost 30 cts. per cubic yard from local pits and 90 cts. per cubic yard from commercial plants. Lumber was bought from stock at $40 per thousand. Reinforcing steel cost 2¼ cts. per pound base.

Costs—In repair work of such varied classes as would nautrally come under a bridge repair department of this type, there are so many small items, incidental to the work, that increase the total cost that it is not quite a fair proposition to figure the total cost of the repair strictly on a concrete yardage basis. We have done this, however, to show relative costs. The most expensive job we did in 1932 ran $12.60 per cubic yard, there being over 40 cu. yds. of concrete in the work. This included all labor and material costs, but does not include gasoline and oil charged against the truck.

On another repair job involving 15 cu. yds. of concrete, the cost was $12.18 per yard. This consisted in widening a small 4x5-ft. culvert from a 16-ft. to a 24-ft. clear roadway. The widening was on both ends of the old culvert and of unequal distances. Handrails and wings were added. On account of the small sections, the cost of placing steel and building forms ran rather high, being $2.05 per cubic yard. The cost of placing concrete on this job, approximately 83 cts. per cubic yard, ran fairly low for the type of mixer used.

The highest cost placing concrete was $1.42 per cubic yard on a 12½-hour run, using 6 men and placing a total of 17.5 cu. yds. By using one less man on this run, and we now believe that as much work could have been accomplished with 5 men, the cost of placing could have been cut 21 cts. per yard. Other things occurring in this day's work helped keep the cost of placing above the average. Costs given above have been for reinforced concrete culverts of the closed bottom and slab types.

Headwalls are constructed of the cantilever type, and are built as far as possible in accordance with standard plans furnished by the county engineer. Costs of such headwalls range from $1.00 to $2.00 less per cubic yard than similar costs for box culverts.

Dry excavation ranged in cost from 40 cts. to 76 cts. per cubic yard, all excavated materials being moved by hand labor and most of the material being handled twice. Wet excavation ranged as high as $1.00 per yard, with two handlings, the extra handling accounting for the higher cost.

The lumber, mainly ship-lap and 2x4-in. studding, was judiciously used. The ship-lap was used on 5 or 6 different jobs before it became useless and the studding was used on almost twice as many jobs. All form lumber was thoroughly oiled before using and cleaned and oiled before each subsequent using. This, we believe, had much to do with the longer usefulness of the lumber. The oil used was waste crank case oil from the county highway garage. Sheet piling was usually oak boards discarded from old bridge floors, or green native stuff, about 1½ ins. thick, from a local sawmill. The cost was $1.25 per hundred.

The concrete mix gravel was always deposited on a 2-in. oak platform along the side of the grade as near as possible to the repair job. Cement was stored at the job in a 6x6x5-ft. shed. This shed is of the sectional, takedown type of six parts including a platform floor, four sides, and a roof section. The sides are dowelled and fastened by plates to the floor and at the corners to each other. The roof is grooved and hooked to the sides. A shed of this type can be taken down or put up in a few minutes' time and is capable of holding over 90 sacks of cement. In two years' time we have not lost, from weather conditions, a single sack of cement stored in this shed. The cost of this shed for labor and materials was $32.50.

We followed the usual methods of construction on concrete work, approaching closely those given by standard state plans, and we believe our results will compare closely with state work. All exposed walls and handrails are rubbed twice. Last fall I inspected some work that had just been completed. The work looked especially good, true to line and whiter than usual. Afraid the workmen had used too much lime, I spoke of the lighter color and found that instead of using the usual sand from the concrete mix gravel, they had used a white blast sand that was worn out and discarded by a local concern. We are going to watch with some interest to see if this concrete holds its good color.

On repairs over streams that have a continuous flow, we have, after much trouble with wooden troughs and smaller pipe, found that the best way to take care of a moderate water flow is to dam the stream above the bridge, and run the water through a suspended, paved invert, corrugated pipe of not less than 18-in. diameter. Especially is this good for a job where the stream channel is to be concreted to stop the scouring of the stream bed.

On wet jobs a small tool that saves quite a little in convenience in getting water for mixing is a pitcher pump mounted on a barrel, supplied with two 10-ft. sections of discarded gasoline hose. This 20-ft. length of hose will pull the water anywhere within its reach.

Summary of Results—At the end of each year a report is made out by the engineer and filed with the board of commissioners. This report gives the number, location, and type of each bridge or culvert repaired. The report also gives a location map of the county showing the location of each repair job. A summary of the work done and recommendations for the coming year are also included. There is also an inventory of tools, equipment, and supplies remaining on hand at the end of the year. A summary of the amounts expended and average costs concludes the report. It is interesting to note that during the year 1931 over 60 per cent of the amount expended went for labor directly on the work.

There seems to be only one objector to the operation of a bridge repair crew of this type, and that is the contractor who has been bidding in work of this kind and deriving some source of income from it.

The benefits are many. Better results seems to me one of the most important. Any engineer who has bucked up against a contractor who was trying to finish a job quickly and cheaply knows that the job is going to suffer in some way, especially with the usual type of inspector on county work.

Another benefit is lower cost. By having the county bridge department handle all repair work up to the $500 limit, the work is done by a trained and efficient crew. The cost of advertising bridge lettings is saved and work is done at actual cost, thus saving a contractor's profit, which on small work of this kind would run to a higher percentage than on heavier jobs.

Control of the spending of the county money is an-

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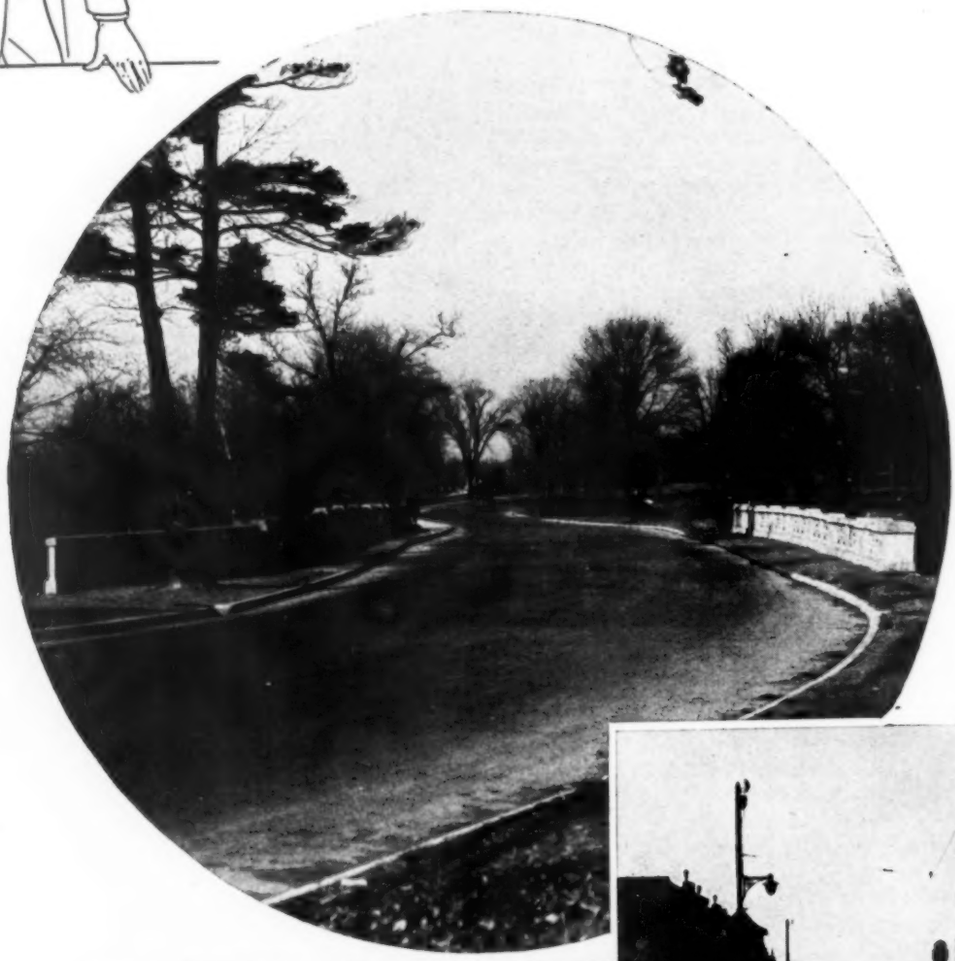

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STANOLIND Paving Asphalt Cement is not simply an asphalt but an asphalt cement whose high qualities are controlled by careful manufacturing and skillful supervision.

Stanolind has the highest of cementing qualities. It meets all recognized standard specifications and requirements for consistency at atmospheric temperatures.

At the proper working temperature, paving mixtures made with Stanolind Paving Asphalt mix readily and are easy to spread to a smooth surface.

The superior qualities of Stanolind Paving Asphalt, such as cementing value, viscosity, and uniformity, are important factors in securing pavements of highest quality with smooth, easy riding surfaces.

Investigate the facts concerning paving asphalt cement if you want the best paving per dollar of cost.

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910 S. MICHIGAN AVE. CHICAGO, ILLINOIS

other benefit. Men who need the work are picked up as extras and given a day's work now and then to keep them off the township poor relief. Only men of family are hired at any time.

Quickness of operation is an advantage. One morning last December the bridge department was notified that the large Howe Truss wooden bridge over one of our streams had been damaged. A truck during the night had side-swiped the end post and knocked out one member and partly unseated another. Within six hours the repair was completed by the bridge repair crew.

The work of the bridge crew is varied. It covers all the classes of repair work that naturally would come up in maintaining the several hundred bridges and culverts of the county highway system. The crew has even been called upon to do other work, such as roadside concrete gutters, retaining walls, etc., for the highway department.

The law enacted by the special session of the legislature in 1932, whereby the limit of repair work was reduced from $500 to $200, has been to the detriment of public interest and funds as far as highway repair work is concerned. This law is not, in any sense, working for true economy and the original limit of $500, or even a higher figure, should be allowed for working limits in repairs of this kind.

Acknowledgment—The foregoing is a paper presented at the last annual Purdue Road School.

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Cane Mat Road Foundations in the Netherlands

A recent report from the Automotive-Aeronautics Trade Division of the U. S. Bureau of Foreign and Domestic Commerce states that the township of Hillegom near the city of Harlem in the western part of the Netherlands, which lies below sea level and where the unstable mud deposited by the Rhine is of unknown depth, has recently begun experiments for the purpose of determining what material is best suited for use as the base upon which to lay a permanent road bed in the bulb districts, where traffic is heavy during certain seasons of the year, but where the soil is of such character that the construction of roads offers many difficult problems.

After experiments with a number of different materials which seemed likely to provide a base which would prevent the road from settling, the success which attended the use of reed mats as a base for a narrow gauge railway in a boggy district in the province of North Holland came to the attention of the road builders in the Hillegom township and a trial section of road about ⅓ mile in length has been laid with a base of reed mats to determine whether or not this type of construction is suitable for general use in loose soil.

The technical, or botanical, name of the reeds, or canes, employed in making the mats is *phragmites communis*. These canes contain a high percentage of silicic acid and are very resistant to rot. They have been used for roofing from time immemorial, and many instances are recorded where roofs of this material have lasted in serviceable condition for 250 years. The reeds used in the trial section are first impregnated with creosote oil under a pressure of 16 atmospheres, and then woven with wire into mats about 10½ ft. long, 5¼ ft. wide, and 2 in. thick. These mats can easily be cut into such smaller sizes as may be desired.

The drainage of the road bed is accomplished by means of porous tiling, but heretofore it has been impossible to obtain the necessary firmness of the road foundation for the reason that the steam rollers crushed the tiling. It has been found that by covering the soft earth foundation of the road, in which the drainage tiles are placed, with a layer of sand about 2 in. thick, and placing the reed mats on top of this layer, the pressure of the wheels of heavy vehicles is evenly distributed over an area sufficiently great to prevent the breaking of the tiles. The paving which is laid on top of the mats consists of special paving bricks united by means of an asphalt composition which breaks down only at exceedingly low temperatures so that there is little chance of the surface of the roadway becoming impaired through the separating of the bricks.

The section of road under construction under the new method will be opened about the middle of October, and as there is a rather dense traffic of heavy trucks over this particular section, it is expected that the suitability of this type of road for general use in boggy districts can be determined at an early date.

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Uniform Numbers for Minnesota Highways

Minnesota's scheme of trunk highway numbering will be considerably changed in 1934 as a result of the taking over by the state of approximately 4,600 miles of new routes added by the last legislature. The state highway department is now completing a plan for co-ordinating the new routes with those of the original trunk system, according to a department bullet. At the same time, methods are being developed for eliminating all cases where the same routes carry different state and Federal numbers. Duplication of numbers on different routes also will be eliminated.

Much confusion is expected to be avoided by the change. Tourist traffic, which depends largely on U. S. route numbers for guidance through the various states, will be greatly accommodated. When the 1934 highway maps are issued no route will carry more than one number. A route having a U. S. number will have the same state number, not a different one. The new routes added by the legislature will be fitted into the numbered system in a practical manner. It will be the purpose to keep the total number of routes under 100.

At the same time that the renumbering is done, Minnesota will join with other states and adopt the national standard of black and white signs for trunk highway guide markers, instead of the present black and yellow. The black and yellow combination will be preserved for warning signs. Route numbers will be shown in black and white.

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20TH ANNUAL PURDUE ROAD SCHOOL.—The 20th annual Road School will be held Jan. 22 to 26 at Purdue University, Lafayette, Ind. A meeting of the program committee was held at Purdue on Oct. 7 to make preliminary plans. This committee is composed of the officers of the cooperating associations in addition to representatives of the state highway commission and of Purdue University.

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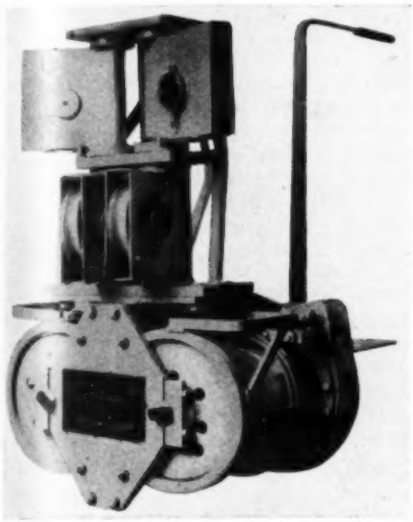
COUNTY MANAGER PLAN ADOPTED BY VIRGINIA COUNTY.—At an election on Sept. 19 Henrico County, Virginia, by a vote of 1,685 to 1,321 adopted the county-manager plan. A board of supervisors will be elected on Nov. 7 and will take office on Jan. 1, 1934, when a county manager will be appointed. The county has a population of 30,310.

New Equipment and Materials

New Double Drum Power Control Unit

A new and highly improved double-arm power control unit has just been announced by R. G. Le Tourneau, Inc., Stockton, Calif., manufacturers of heavy earth-moving equipment. The new unit carries more than twice the amount of line and has more than twice the amount of pulling power that the old Le Tourneau double-drum unit possessed. It also has the lead sheaves above the drums instead of below, which most contractors find improves convenience, and has fairleads on



New Le Tourneau Double Drum Power Control Unit

both lines so they can be led in any direction.

Like the old double-drum power control unit, the new equipment is intended for operation of Le Tourneau scraper and Le Tourneau tractor derricks. It is also applicable for operation of any other equipment requiring two lines and, by leaving one line idle, for operation of bulldozers, Le Tourneau Angledozers, Le Tourneau booters or other equipment requiring but a single line for operation. It will also operate a bulldozer or angledozer and cowdozer on the same tractor, one line for each, or bulldozer and dumpcart on the same tractor, one line for each. Or a bulldozer can be operated and one line left free to move rock, stumps, etc.

Specifications of the new unit follow.

Drums, 8 in. diameter, 8 in. long.
Drum flanges, 13 in. diameter.
Size of sheaves, 9 in.
Line pull, bare drum, 9405 lb.
Line pull, full drum, 5824 lb.
Line speed, bare drum, 200 feet per minute.
Line speed, full drum, 325 feet per minute.
Size of tractor, 35 to 80 in.
Weight, plain power unit, 1,000 lbs.
Weight, double deck large sheave, 300 lbs.
For export with double deck large sheave, 20¾ cu. ft.
For export, double deck large sheave only, 4½ cu. ft.

As in the former type control unit, one lever controls each drum; pulling it one way releases the drum and allows the line to run out; pulling it the other way actuates the drum and reels in the line; releasing the lever locks the drum. The same man who operates the tractor readily controls both drums. Timken bearings and alloy steel gears are used.

Littleford Trail-O-Distributor

A new piece of equipment, known as the Trail-O-Distributor, for distributing bituminous material has been added to the line of Littleford Bros., 454 E. Pearl St., Cincinnati, O.

The Trail-O-Distributor is nothing more or less than the working end of a Littleford pressure distributor mounted complete on a separate trailer unit. The high speed trailer is equipped with pneumatic tires, Timken roller bearings and semi-elliptical springs. The novel feature of the trailer is its adjustable tongue which can be made to fit trucks of any height. This feature is very desirable as, quite frequently, trucks of different makes are used with the supply tanks to which the Trail-O-Distributor is to be connected. After the spray bar on the Trail-O-Distributor is adjusted to the desired position, it is unnecessary to make further adjustment when supply tanks are changed—the adjustable tongue takes care of differences in truck heights and the spray bar remains in the correct position. There is ample walking space around the outfit and operator can adjust pulling tongue to supply tanks without getting off the outfit.

The Trail-O-Distributor can be provided

Littleford Trail-O-Distributor

with either a 200 or 300 gal. pump. It has the Littleford single valve control. With the single valve control, it is possible to suck material from spray bar back to tank, thereby entirely eliminating dripping after spraying is cut. This valve mechanism is so arranged that 1 or 2 connecting hoses to tank can be used. If the supply tank has a heating unit, it is possible, with two hoses, to circulate material in tank while temperature is being raised. If it is not necessary to circulate material, only one hose need be hooked up to the supply tank.

Another exclusive Littleford feature is that all pipe fittings, pump, and valve mechanism are enclosed in a chamber enabling the operator to warm these parts when operating in cool weather. It is also arranged so that a burner can be placed in this hood.

New Air-Cooled Engine

Designed especially to supply the demand for an air-cooled engine in the compressor, truck, tractor and general industrial field, a new 6-cylinder power plant, developing 104 brake horse power at 2600 r.p.m. with 4 in. bore and 5 in. stroke, has just been announced by Doman-Marks Engine Co., Amesbury, Mass. This engine, together with complete lines of 4, 8, and 12-cylinder power plants, which are now being designed, will enable any manufacturer of equipment calling for horsepower from 12 to 200, to use air-cooled power.

The cooling air, supplied by a large centrifugal blower mounted on the crankshaft,

Doman-Marks Air Cooled Engine

divides into two distinct streams one going to the cylinder heads, and one to the cylinder barrels, thus eliminating eddy currents in the ducts.

An outstanding feature of this engine is its uniform valve compensation regardless of temperature. Valve lifters are of the mushroom type, having a chilled cast iron surface in contact with the cams. The valve lifters function in specially designed hydraulic chambers which keep the valve clearances uniformly at zero regardless of engine temperature.

In keeping with the advanced design of this air-cooled power plant, the crankcase is of rugged construction, adequately ribbed, and drilled throughout for the oiling system, doing away with all pipes and connections. All the oil, before it passes to the connecting rods and main bearings, goes through an oil temperature regulator which is inserted in series with the main feeder to the bearings.

Lubrication efficiency is furthered by other special features. The crankcase breather and oil filler are combined so that the oil pan can be filled from either side. Also, a specially designed rear bearing cap prevents the oil from running out of the oil pan when the engine is used at a considerable angle as is continuously required in heavy duty work.

This new power plant has separately cast cylinder heads of aluminum which are screwed onto the cylinder barrel at a tem-

perature of 550 degrees F which is well above that ever attained in service; thus the heads shrink on the barrels and never come off. Valves can be removed without removing the heads from the cylinders. On account of the extreme accessibility of the various parts of this engine, it is possible to remove all cylinders, grind valves, and clean carbon in approximately the same time as is required in a similar size water cooled engine.

The engine just described, Model 16A-377, is the first one of a series which is now being designed. This line of power plants will ultimately cover the entire automotive field.

New Dragline

A new larger dragline announced recently by the Northwest Engineering Co., 28 East Jackson Blvd., Chicago, Ill., is stated to bring large capacity combined with a simplicity, mobility and economy ordinarily not found in machines of this size.

The power plant is an 8 in. x 9 in. Northwest-Twin City engine, operating as slow speed, which with other advantages of design gives torque characteristics and hanging-on qualities that meet the drag-down loads of dragline service. Power takeoff is through helical cut gears enclosed and mounted on ball and roller bearings and running in oil.

New Northwest Dragline

The Northwest cushion clutch is provided as standard equipment. This device acts as a guard against the overloads that come when the bucket strikes rocks, stumps or other firmly anchored articles. It transmits the full engine power but reduces maximum stresses on every part under power when the hoist rope is tensioned. It increases cable life and reduces loads on the drum shaft.

Particular attention has been given to the swinging clutches. These are of the cone type and are provided with oversized blocks, giving smooth, even engagement, uniform pressure and long life.

Steering is accomplished in the exclusive Northwest manner with positive traction on both crawlers while turning as well as when going straight ahead. All gears in the crawler base are fully enclosed by a heavy housing and gears run in oil. Treads are self-cleaning.

Through the ingenious use of hold-down rotating rollers the diameter of the rotating path is in effect doubled. This design resists the tendency of the rotating base to "pry" away from the crawler base. Short tail swing, compactness, ability to ship without major dismantling, and the elimination of useless weight are all directly associated with this advantage.

Large boom point sheaves lubricated by an oil reservoir and an improved revolving fairlead help to make this new Northwest an exceedingly modern piece of equipment.

New Federal Trucks

The Federal Motor Truck Company, Detroit, Mich., has started production on four new six-wheel trucks. Models 16 with single drive, and 17 with tandem drive, are of 3-ton capacity. The other two, known as Models 36 and 37, are rated at 4½ ton and have single and tandem drive respectively.

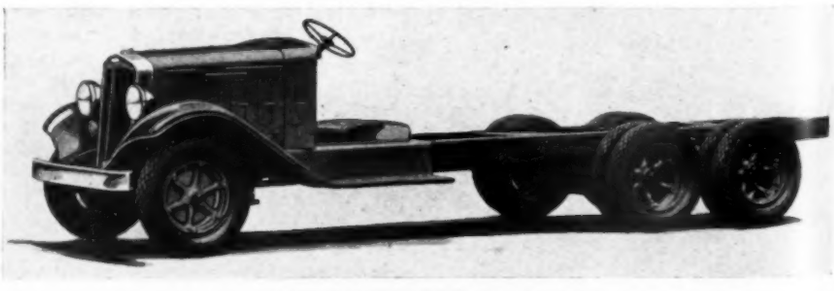
These new models incorporate a patented basic 6-wheel design. New and larger power plants, heavier frames and various other improvements now provide greater value, stronger construction and better performance.

Models 16 and 17 are powered with a 6-cylinder 7-bearing truck engine 3⅝ in. bore by 4¼ in. stroke. Clutch is of the single dry plate type, 11 in. diameter, equipped with vibration dampener. A 4-speed transmission is mounted in unit with the engine. Frame is extra heavy fish belly type with a maximum depth of 8½ in. Hydraulic brakes 15 in. diameter by 2¼ in. wide with cast drums operate on all six wheels. Standard tires are 6.00/20 truck type balloon front and 32x6 8-ply single high pressure on four rear wheels mounted on cast steel spoke wheels. Dual rear tires are supplied optional at extra cost. Three wheelbase lengths are available: 172 in., 185 in., and 198 in.

Federal's patented six-wheel rear end design is employed which includes double rear springs on each side connecting the two rear axles. These springs are attached to a large bracket at the center which pivots on a trunnion pin with large double bearings. The Model 16 single drive unit has a full floating bevel axle at the rear ahead of which is a dead axle of tubular construction with a cast steel drop center. On the Model 17 the rear end design is the same except that there are two driving axles instead of one. Power is applied to the four rear wheels through two bevel gear type full floating axles which are connected with an intermediate propeller shaft having a pinion at each end. This dual bevel drive is an exclusive Federal development.

Models 36 and 37 are equipped with a unit power plant comprising a six-cylinder, 7-bearing engine, 4⅛ in. bore by 4¾ in. stroke, a 13 in. single dry plate clutch and a 5-speed transmission with silent fourth. Frame is fish belly type with a maximum depth of 10 in. Universal joints are of the latest roller bearing type. Braking system is hydraulic operating on all six wheels and amplified by a vacuum booster. The size of brakes are 16 in. by 2¼ in. front and 16 in. by 3 in. rear. Brake drums are cast iron. Ventilated disc type wheels carry 7.50 by 20 8-ply balloon tires, single front and dual rears. Wheelbase lengths supplied are 192 in., 205 in. and 218 in.

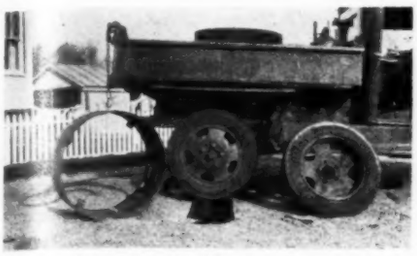
On Models 36 single drive and 37 tandem drive the rear end construction is of the same general design as described above for the smaller models except that the axles, springs, brackets and other parts are larger and heavier in proportion to the increased capacity.



New Federal 6-Wheel Truck

Auxiliary Wheel for Converting Truck into Roller

An auxiliary roller wheel by means of which any small dual-pneumatic-tired truck may be used as a maintenance roller and for patch work, shoulder repairs, etc., has been placed on the market by the New England Culvert Co., 10 Alger St., Boston,



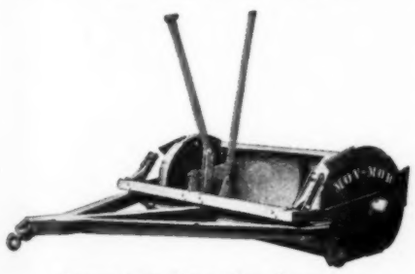
Lawrence Auxiliary Wheel at Left; Note Lugs

Mass. This roller wheel consists of a 17 in. wide steel band that fits over the rear wheels of a dual-pneumatic truck and is held in place by means of a series of flanges between the sets of tires. A patent has been applied for and it is expected will be granted shortly. It does not affect the traveling or riding qualities of the truck at a reasonable speed. It may be left on or removed with but little effort. Both wheels may be equipped or one wheel only, depending upon the work to be done. The change requires three simple operations requiring not more than 10 or 15 minutes for each wheel.

New Revolving Type Scraper

A new revolving type scraper, made under the Reynold's patents but embodying several construction improvements, has recently been placed on the market by the Davenport Locomotive & Manufacturing Corporation, Davenport, Ia.

In addition to being instantly responsive to the control of the tractor operator and being capable of scraping lightly, digging deeply and spreading the load or dumping completely without a change of stops, the Davenport Mov-Mor Scraper is extremely rugged. The cross member of unusually strong box beam construction, the steel box beam tongue and heavy channel stiffeners, and the heavy reinforced bowl give the Mov-Mor the ruggedness required for



Davenport Mov-Mor Scraper

preventing buckling or twisting in hard, gruelling service.

The tongue is equipped with swivel draw bar which eliminates shocks on the tractor as well as the scraper. The bowl is designed, free from obstruction, so as to permit free discharge of load.

Another feature, intended to contribute to long service life and trouble-free performance, is the fact that the bottom board and cutting edge of the Davenport Mov-Mor scraper are made of high carbon steel capable of withstanding wear far in excess of ordinary construction.

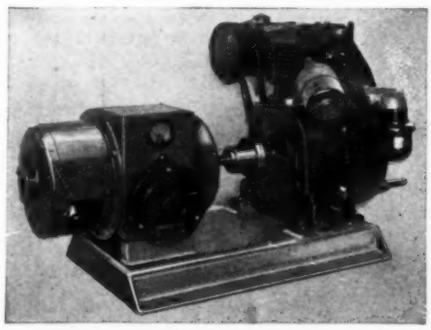
Sturdy and positive operating controls insure instant response to the commands of the tractor operator. A full range of versatility is insured by quickly adjusted dig-in stops.

The Davenport Mov-Mor Scraper is made in seven sizes ranging in cubic foot capacity from 12 to 56.

New Portable Lighting Plant

An interesting development in the field of electric generating units recently perfected by the Harnischfeger Corporation, Milwaukee, Wis., is a line of portable lighting plants.

The small, heavy duty line of lighting units consists of a 1 or 2-cylinder gasoline engine directly coupled to a compound wound, continuous generator. Push button or manual starting is available. Capacities range from 400 watts to 3 K.W. generating 35 or 120 volts direct current. Greater capacities are provided for by



New Harnischfeger Portable Lighting Plant

4 and 6 cylinder gasoline generator sets with a current range of 1½ to 60 KW.

In addition to these gasoline driven sets, diesel power is also available. The diesel engine operates on cheap fuel oil and consumes less than half the amount of fuel necessary to operate the gasoline engine. These modern diesel generator sets are built in capacities of 35 and 50 KW, alternating or direct current.

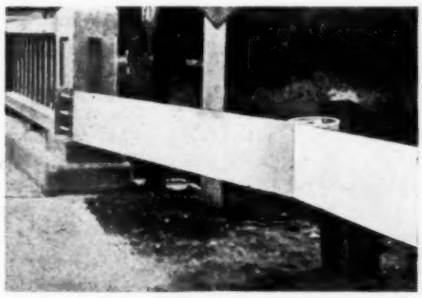
Because of the large capacity of these units, electric lights and appliances may be operated simultaneously. Features claimed for the line are high reserve capacity, economical operation, simplified design and continuous non-flickering current.

These generating sets are being marketed by the newly organized electrical division which is now handling the Hansen Arc Welder, a new line of electric motors and heavy duty controllers.

A New Highway Guard Rail

A new guard rail for highways has been developed recently by Truscon Steel Co., Youngstown, O. This new product Truscon "Duraguard" is a resilient construction designed to withstand a severe shock by absorbing the initial blow of a vehicle and then deflecting it to a position parallel to the construction so that its momentum may be checked easily.

Two types of brackets are used: a rigid type especially adaptable to rigid steel up-



Front View Bridge Connection and Second Post

rights on bridges and viaducts, and a cushion bracket adaptable to all general guard rail use.

The plates are steel, 12 in. wide, with reinforced end connections fitting either the rigid or the cushion bracket type as well as with end post and bridge end connections. All sheets are true and so fabricated that they will take care of expansion and contraction as well as serve to keep the entire section of guard rail in tension at all times. Plates are furnished galvanized or painted.

Unless otherwise specified all sections will be standard lengths: intermediate sections, 15 ft. 11¾ in., and end sections 7 ft. 6 in. These sections require post spacings 16 ft. on center except the end sections which are 8 feet on center. If on account of some special conditions (such as a section between two bridges) it is necessary to have other than these standard length sections, they can be furnished without delay.

Drifter Drill Auto-feed

An automatic feeding device for drifter drills which makes hand cranking unnecessary has been introduced by Ingersoll-Rand Company, 11 Broadway, New York City. In addition to eliminating the need for constant attendance of the drill and thereby freeing the operator for other duties, the

Auto-Feed, Showing Ease of Reversing Direction of Feed

auto-feed is stated to increase the production per drill.

The auto-feed makes use of no power medium and is completely automatic. It derives its action from the natural tendency of a running drill to creep when the feed

screw is allowed to turn in only one direction. The mechanism, which is attached at the end of the feed screw, consists of two ratchet heads, around each of which is a ratchet ring having both internal and external teeth. Pawls on the two ratchet heads are arranged so that, depending upon the direction of rotation, the feed screw is locked to one or the other of the rings. This serves to feed the drill either forward or backward, according to which ring is locked. The direction of feed can be reversed by throwing a conveniently located lever. A brake permits retarding the rate of feed or stopping it entirely. When drill it not running, it can be freely moved in the shell.

When starting a hole, the operator feeds the drill up to the rock face slowly by opening the air throttle partially. When the bit reaches the rock, he opens the throttle further. In even ground, after the hole is collared, he need pay no more attention to the drill until a change of steel is necessary; in broken or fitchery ground, by proper manipulation of the auto-feed, he is able to put in holes easily where it would be extremely difficult or sometimes impossible to do so with the hand crank. By reversing the direction of rotation, the drill will automatically run back. This reduces the time required to change steels.

Other advantages claimed for the auto-feed are: greater over-all footage per man shift; better control of the drill in fitchery ground; it pulls tightly held steels that are difficult or impossible to extract by hand cranking; it will operate in close quarters and permits placing edge holes where blasting will prove most effective —something that is often impossible with hand cranking because of the scant room available.

Drills equipped with auto-feed are but slightly longer and heavier than hand-cranked models. There is no increase in air consumption. The construction is simple and upkeep cost is low.

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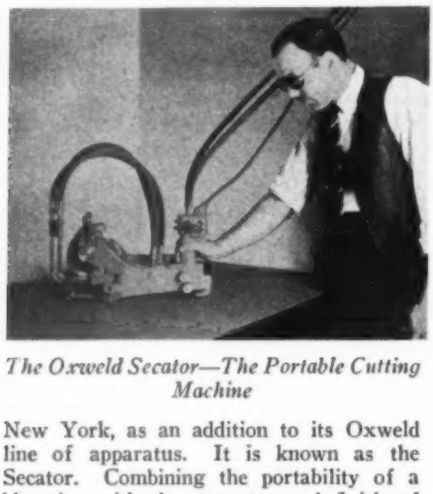
New Portable Cutting Machine Announced

A portable cutting machine weighing but 43 pounds has been announced by The Linde Air Products Co., 30 East 42nd St., New York, as an addition to its Oxweld line of apparatus. It is known as the Secator. Combining the portability of a blowpipe with the accuracy and finish of a cutting machine, the Secator makes it possible to do high-quality cutting anywhere in the shop or in the field.



The Oxweld Secator—The Portable Cutting Machine

Essentially it consists of an Oxweld Type C-14-H blowpipe (especially designed for it) mounted on an electrically driven, air-cooled, dust-proof chassis. It is equipped with a direct drive and runs either on a 1½ in. angle-iron track, furnished with it, or on any relatively smooth plate. When operated on the track, it does straight-line cutting automatically. For cutting simple shapes it can be guided with a hand-grip. For automatic circle-cutting, a center and a radius rod are furnished. For convenience of control, the oxygen and acetylene valves are on the chassis rather than on the blowpipe. The blowpipe can be adjusted vertically and horizontally and also to cut bevels up to 45 degrees. Its cutting range is that of the C-14 blowpipe and the cuts are so clean and smooth that for many purposes machining is stated to be unnecessary.

A universal motor that may be used on either 110- or 220-volt circuits operates the Secator. Even inexperienced workers can quickly learn to handle this machine with ease.

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New Wagon Drill

A new wagon drill has been brought out by the Gardner-Denver Co., Quincy, Ill. In this outfit the height to top of drill steel guide is 16 ft. 4 in., the height to drill steel handling pulley is 13 ft. 1½ in. and the height to top of pulley handling drill is 13 ft. 5 in. The maximum possible steel change is 11 ft. The width over all is 6 ft. 4 in. The length of derrick-wheel base of wagon is 7 ft. 2 in. The weight with air hoist is 2,055 lb.

New Gardner-Denver Wagon Drill

The wagon is strongly constructed of I-beams, channels and angles. The heavy square axle is offset, carrying the wheels well forward to eliminate the danger of upsetting the outfit when pulling a tight steel with the air hoist.

The one-piece cast slide to which the drill is bolted, is arranged to take any size Gardner-Denver drill. The clamps and bolts hold the drill securely to the slide, and are completely accessible from the rear by raising the drill so that it clears the "ladder." There are no annoyingly close wrench clearances.

When used with extra long steels, the outfit can be equipped with a hand winch with cable and steel puller for raising and lowering the steels, and with an extension and guide by which they can be safely handled.

A substantial tow-bar with swiveling wheel makes it easy to move the rig from place to place.

In rough ground holes may be spotted and collared easily because of the quick acting convenient centralizer. The air hoist throttle and the drilling and blowing controls are all within easy reach of the operator. Only one string of pipe and one piece of hose are necessary from the compressor to the drill.

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Brookville Announces 6-Ton Locomotive Powered with "Caterpillar" Diesel Engine

A new 6-ton Brookville locomotive, powered with a "Caterpillar" Diesel engine, has been announced by the Brookville Locomotive Co., Brookville, Pa.

The engine is a "Caterpillar" 3-cylinder Model D-6100 Diesel, developed primarily for heavy duty tractor service, but ideally adapted for industrial locomotives.

6-Ton Brookville Locomotive Powered with "Caterpillar" Diesel Engine

The Brookville chassis is almost the same as those used by Brookville for gasoline-powered locomotives. It is of heavy, rugged construction, free from complicated parts and of simple design, now almost fool-proof after sixteen years of improvement.

The "Caterpillar" engine develops 37 brake HP at 850 r.p.m., with a peak of 47 HP for intermittent loads. It can be operated over a wide speed range, and at slow speed has an even better torque characteristic than the gasoline engine. This abundance of flexible power, transmitted in four forward and four reverse speeds, gives the locomotive sufficient power to slip all four drive wheels on a dry, sanded rail, or to obtain a maximum speed of 15 miles per hour.

New Hydraulic Snow Plow

A high speed snow plow that fits any 1½-ton truck is a recent product of The Austin-Western Road Machinery Co., Chicago, whose broad line of snow removal equipment embraces all types of plows for both truck and tractor use. Tapered and deeply curved to pick up, "spiral" and throw the snow, this plow can be worked at the highest operating speeds; pronounced curve of blade successfully prevents snow from clouding the windshield and clogging up radiator. A few easy strokes by driver within cab, operates hydraudic (oil) pump to raise blade; turning a small thumb screw valve lowers blade rapidly or slowly as desired or locks it in place. A simple but rigid attachment to front of truck makes for quick mounting to, and easy removal from, truck. Novel toggle release permits obstruction to pass under blade when it strikes man-hole cover, traffic marker, etc.; blade readily assumes its normal position when truck is backed up. This snow plow attachment, known as the No. 1½, provides the utmost in driver convenience and safety.

New Austin-Western Hydraulic Snow Plow

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Abrasive Blast Testing Machine for Road Material

A machine for testing paving materials, building stone, cement tile, etc., by means of an abrasive blast, has been put on the market by the MacLeod Co., 2232 Bogen St., Cincinnati, O. The extremely hard grains used in the blast break loose small particles from the tested material, giving structure reliefs. In addition to these reliefs, the blast may be used for comparative measurements between different kinds of stones. This is done by exposing the sample to the action of the blast under exactly uniform conditions for a predetermined time and using the measure by weight of the material removed as the basis of comparison.

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A Black Pigment for Coloring Concrete

A black pigment for coloring concrete pavement, sidewalks, driveways, floors and all forms of architectural concrete has been placed on the market by Godfrey L. Cabot, Inc., 940 Old South Bldg., Boston, Mass., one of the oldest manufacturers of carbon black in America. This product, known as Charon, is an emulsion in which the particles of pigment, many thousands of times finer than ordinary "dry" pigments are held in suspension. It is claimed to give concrete, without injury to strength, or toughness (wear resistance), a uniform gray of any desired depth of color, up to and including a practically pure black. This emulsion is stated to disperse instantly, on contact with water, thus acting almost as a dye, to color the entire mass of concrete uniformly, quickly and effectively.

Charon is ordinarily delivered to the job in sealed 6 gal. containers. The container is opened and the charon in the quantities required poured over the aggregate in the charging hopper, just before it is emptied into the mixer. On large jobs it can be furnished in bulk containers, or in tanks. Charon is constant in composition and batch lots can be measured either by volume or by weight.

For sidewalks, or other work where a distinctly dark color is desired, 2 quarts of Charon are used per bag of cement. For streets, driveways, and parking areas, etc., 1 quart of Charon per bag of cement will make a sufficiently dark concrete. It is stated that for a two-course pavement, the Charon in a 2-in. top course will cost only about 5 cents to 7 cents per square yard.

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Recent United States Patents Relating to Roads

Compiled by Patent & Technical Information Service 1336 New York Avenue, N. W., Washington, D. C.

SEPTEMBER 5, 1933

1,925,306. **Road Scraper.** George E. Dean, Grand Rapids, Mich., assignor to Charles G. Willett, Grand Rapids, Mich. In combination a truck, a beam adjustably mounted on and below said truck whereby the same may be adjusted to a plurality of different angular positions with respect to the length of said truck, a scraper blade carried by said beam and mounted thereon to turn about a horizontal axis, a casting secured to said beam having a part extended rearwardly of the beam and terminating in a downwardly extending cylinder head, a cylinder secured thereto, a piston in said cylinder, a rod extended from said piston through said head of the cylinder, guides of said casting through which the rod passes, means connecting the piston rod with the scraper blade whereby the scraper blade is rocked about its horizontal axis on longitudinal movement of the piston rod, and means for selectively pumping liquid into either end of said cylinder.

1,925,318. **Earth Working Implement.** Gerald Geraldson, Racine, Wis., assignor to J. I. Case Co., Racine, Wis. In an earth working implement, a beam adapted to be pivotally connected to a tractor, a tool at the rear end of the beam, a frame extending from the beam and forming a continuation thereof, a gage wheel support, means for pivotally connecting the support to the frame and whereby the support may be adjusted higher or lower in relation to the frame, a lever, and means connecting the lever and support for moving the latter rearwardly in inclined position and also forwardly in substantially vertical position in relation to the frame.

1,925,635. **Manhole Cover and Frame.** Cyril John Hartley, Stoke-upon-Trent, England. In combination, a triangular manhole cover, a frame therefor, bosses carried by and depending below the manhole cover at the respective ends of one side of said cover, pads on the frame to provide bearing supports for the bosses in all relative positions of the cover, means for pivotally connecting the frame and cover, a boss depending from the cover at the meeting ends of the remaining sides of the cover, and a pad on the frame to receive the last named boss.

SEPTEMBER 12, 1933

1,926,142. **Skip Boom and Skip for Concrete Pavers.** Fred L. Dake, Nunda, N. Y., assignor to The Foote Co., Inc., Nunda, N. Y. In combination with a concrete paver, a pivotally mounted skip, a skip boom pivoted at its rear end to said paver and extending directly over the central longitudinal axis of the skip arms pivotally connected to both the skip and the skip boom, a cable for elevating and lowering said skip and an elevating of the skip causing an elevating of said skip boom.

1,926,193. **Leveling and Troweling Device for Concrete.** Byron S. Clark, Chicago, Ill., assignor, by mesne assignments, to Benedict Stone Products Co., Chicago, Ill. In a combined leveling and troweling device, the combination of an elongated sheet metal member formed with a horizontal flange having a lower smooth troweling surface, and with a vertically extending flange adapted to level off the surface of the concrete, a pair of upwardly extending handles carried by said vertical flange and located one at each end of said elongated metal member, and a plurality of vibrators carried by said elongated metal member and located at predetermined points, each of said vibrators comprising an air hammer, a bracket carried by said elongated metal member, clamping means carried by said bracket for securing said air hammer in position to engage said elongated metal member, and a vibrating impact member carried by said air hammer and adapted to engage said elongated metal member.

1,926,323. **Support for Concrete Reenforcement and Joints.** Walter L. Whitman, 2d., Philadelphia, Pa. A reenforcement support comprising a frame adapted to be placed on side forms, in vertically spaced relation to and bridging a road bed, and pairs of depending members carried by said frame and having their lower portions formed to abut against horizontally-extending dowel bars, the members of each pair being spaced laterally of the frame.

1,926,397. **Precision Apparatus for Cutting Roads to Final Grade.** Joseph H. Mosel, Columbus, O., assignor to The Jaeger Machine Co., Columbus, O. Apparatus for cutting dirt surfaces to grade comprising a framework, a plurality of cutter elements, said cutter elements being disposed across a framework, said cutter elements being provided with radial wedge-shaped cutter blades and radial breaker teeth, means for driving said cutter elements, and means for adjusting said cutter elements.

1,926,516. **Road Joint and Method of Making Same.** Walter S. Edge, Pittsburgh, Pa., assignor, by mesne assignments, to Pittsburgh Steel Co. The method of forming a joint or plane of weakness in concrete which comprises cleaving the material along a predetermined line and simultaneously smoothing the walls of the cleft, while the concrete is still plastic, the cleft being of such narrow width that the walls thereof may move into contact with one another without cracking of the concrete body, and introducing a cold liquid filling material into the cleft.

1,926,624. **Apparatus for Transporting Concrete.** Edward A. Hoffman, Reading, Pa., assignor to Clinton Motors Corporation, Reading, Pa. Apparatus for transporting wet, flowable concrete adapted to be mounted on a truck interchangeably with a standard dump body, comprising a frame, a tank carried by said frame, a motor carried by said frame for rotating said tank, a trunnion bearing and a support therefor disposed between said motor and said tank, said support also having means for supporting one end of the power shaft of the motor.

1,926,633. **Concrete Culvert Form.** Chasteen F. Scott, Oklahoma City, Okla. In a concrete culvert mold form, side walls arranged in spaced parallel relation, a core arranged between the walls, plates projecting from corresponding ends of the side walls and coextensive in height therewith, angular shaped plates projecting from the aforementioned plates, wing walls connected with the angle plates and arranged in divergent relation, base plates horizontally supported on the upper edges of the first mentioned plates spaced transversely disposed reinforcing plates reposing edgewise on the base plates, angle shaped brackets arranged between and connecting the adjacent ends of the transverse reinforcing plates, and depending portions carried by said transverse plates and of a length to fit between the first mentioned plates secured to the side walls.

1,926,667. **Worm Drive Road Roller.** Frank S. Davis, Flossmoor, and Hugh D. Woodier, Harvey, Ill., assignors to Austin Manufacturing Co., Harvey, Ill. In a road machine, a power plant for said machine, a worm connected to the drive shaft of said machine, a worm gear located below said worm for driving said machine in forward direction, and a second worm gear located above said worm for driving said machine in reverse direction, said gears being mounted on quills, clutch discs attached to said quills, a shaft freely rotatable within each of said quills, clutch discs connected to said shafts and adapted to be engaged and rotated by the clutch discs attached to said quills, and a gear mounted on each of said last mentioned shafts and rotated thereby for operatively driving said machine in either of two directions.

1,926,895. **Pavement Marking Device.** Albert C. Fischer, Chicago, Ill., assignor to The Philip Carey Manufacturing Co. In an apparatus for jointing a plastic surface, a post, a boom projecting therefrom, marking means carried by the boom, and means for actuating the marking means relative to said boom.

SEPTEMBER 19, 1933

1,927,189. **Automobile Highway Safety Wall.** Martin L. Sory, Bellingham, Wash. A marginal safety wall along a roadway having the side thereof adjacent the said roadway continuously curved upward and inclined outwardly from the said roadway, and a convex coping on the top of the said wall overhanging the said curved surface thereof adjacent the said roadway.

1,927,303. **Highway Guard.** Edward L. Benedict, Oakmont, Pa. A guard fence comprising a post, a flexible impact-receiving member, means for anchoring said member adjacent to its ends, a pair of vertically-extending rib-like projections on said post, means for drawing the adjacent portion of the band into the space between said projections, and means for yieldably maintaining the band in said positions.

1,927,679. **Road Grader.** Perry A. Brick, Rome, N. Y., assignor to Revere Copper & Brass, Incorporated. In road grading apparatus, a front end assembly combination comprising, a grader supporting frame, a main-axle pivotally mounted to rotate with respect to said frame, stub-axles connected to the ends of said main-axle by knuckles having horizontal and vertical axles, means for rotating said main-axle about its pivotal mounting, and independent means for rotating the stub-axles about their horizontal or vertical axes.

1,927,680. **Road Grader.** Perry A. Brick, Rome, N. Y., assignor to Revere Copper & Brass, Incorporated. In a grading machine, a frame, a rear axle assembly comprising an axle, a pair of wheels associated with opposite ends of the axle, means for shifting the frame relative to the axle, means for tilting the wheels about transverse axes and a single member operatively connected to the axle shifting and the wheel tilting means for selectively operating either of said means.

1,927,756. **Traffic Lane Marker.** David E. Ross, Lafayette, Ind., assignor to Purdue Research Foundation, Lafayette, Ind. A traffic lane marker; comprising an elongated oval shaped body adapted to be secured in a roadway and having an approximately parti-spherical upper surface adapted to project slightly above the surface of the roadway, said body having a longitudinal open groove in its top portion; a partition secured to the body at the center of the groove, and a reflecting lens in said partition adapted to reflect the light of an approaching automobile.

1,927,757. **Traffic Lane Marker.** David E. Ross and George Stanley Meikle, Lafayette, Ind., assignors to Purdue Research Foundation, Lafayette, Ind. A traffic lane marker adapted to be secured to the surface of a roadway between opposite lanes of traffic; comprising a body having its central portion adapted to project slightly above the surface of the roadway and inclined downwardly toward each end and side; said body having recesses in opposite sides extending towards opposite ends of the body, each recess beginning at a point adjacent to the center of the body and extending toward the adjacent end thereof, and a reflecting lens at the inner end of each recess.

Statement of the Ownership, Management, Circulation, Etc., Required by the Act of Congress of August 24, 1912,

Of Roads and Streets, published monthly at Chicago, Illinois, for October 1, 1933.

State of Illinois, County of Cook, ss.

Before me, a Notary Public in and for the State and county aforesaid, personally appeared E. S. Gillette, who, having been duly sworn according to law, deposes and says that he is the business manager of Roads and Streets and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, Gillette Publishing Co., 400 West Madison St., Chicago, Ill.

Editor, H. P. Gillette, 400 West Madison St., Chicago, Ill.

Managing Editor, C. T. Murray, 400 West Madison St., Chicago, Ill.

Business Manager, E. S. Gillette, 400 West Madison St., Chicago, Ill.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.)

Gillette Publishing Company, 400 W. Madison St., Chicago, Ill.

H. P. Gillette, 400 W. Madison St., Chicago, Ill.

Mrs. R. W. Hume, 303 S. Stone Ave., La Grange, Ill.

E. S. Gillette, 400 W. Madison St., Chicago, Ill.

Winifred Gillette, 1125 Oak Grove Ave., San Marino, Calif.

Provident Trust Company, 17th and Chestnut Sts., Philadelphia, Pa.

Louise Forsythe, 13 E. Windemere Terrace, Landsdowne, Pa.

La Verne Louer Hellyer, Ambassador Hotel, Chicago, Ill.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages or other securities are: (If there are none, so state.)

None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

E. S. GILLETTE,
Business Manager.

Sworn to and subscribed before me this 22nd day of September, 1933.

KITTIE C. WOULFE,
(Seal) Notary Public.

(My commission expires Feb. 8, 1934.)